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THE

AMERICAN JOURNAL

OF

SCIENCE AND ARTS.

CONDUCTED BY

BENJAMIN SILLIMAN, M. D. LL. D.

Prof. Chem., Min., &c. in Yale Coll.; Cor. Mem. Soc. Arts, Man. and Com.; and
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ERRATA.

The reader is requested to correct the following errata in Vol. XXX. of the American Journal of Science. The writer of that article, at the time of its publication was in the Indian country, on Red river, several hundred miles west of the Mississippi, where the proof sheets could not be sent to him; and it is only since his return from that part of the country, that he has seen the article in print. There are several errors in punctuation, but the verbal errors only will be noticed.

W. W. MATHER, *Mining Engineer.*

P. 326, l. 3 fr. bot. for *quality*, read *equality*.—P. 328, l. 9 fr. top, for *exhaustible*, read *expansible*; l. 11 fr. top, for *will thrust*, read *will be thrust*.—P. 329, l. 7 fr. top, for *those*, read *that*.

Vol. XXXII.—P. 272, l. 5 fr. top, for 9, read 266.—P. 290, l. 17 fr. top, for *opposite*, read *preceding*.

CORRECTION.

In Prof. Green's notice of Trilobites, in this No. p. 169, for *Asaphus Platypleurus*, read *Trimerus Platypleurus*, this correction being made in consequence of the examination of more specimens from the same locality.

ACKNOWLEDGMENTS TO CORRESPONDENTS, FRIENDS AND STRANGERS.

Remarks.—This method of acknowledgment has been adopted, because it is not always practicable to write letters, where they might be reasonably expected; and still more difficult is it to prepare and insert in this Journal, notices of all the books and pamphlets which are kindly presented, even in cases, where such notices, critical or commendatory, would be appropriate; for it is often equally impossible to command the time requisite to frame them, or even to read the works; still, judicious remarks, from other hands, would usually find both acceptance and insertion.

In public, it is rarely proper to advert to personal concerns; to excuse, for instance, any apparent neglect of courtesy, by pleading the unintermitting pressure of labor, and the numerous calls of our fellow-men for information, advice, or assistance, in lines of duty, with which they presume us to be acquainted.

The apology, implied in this remark, is drawn from me, that I may not seem inattentive to the civilities of many respectable persons, authors, editors, publishers, and others, both at home and abroad. It is still my endeavor to reply to all letters which appear to require an answer; although, as a substitute, many acknowledgments are made in these pages, which may sometimes be, as now, in part, retrospective.—*Ed.*

DOMESTIC.

An Address before the Law Association of the City of New York, by the Hon. James Kent. Two copies; one from the Author, the other from B. D. Silliman, Esq.

Report on a Geological Survey of the State of Ohio. Three copies, from Mr. Seabury Ford, R. Granger, Esq. and Dr. S. P. Hildreth.

Lecture before the Law Class of Transylvania University, by Geo. Robertson, LL. D. From J. G. Martin, Esq.

A Friend to the South. Boston, 1836.

Letter of Rev. Wm. E. Channing to James G. Birney. Author.

Essay on the influence of Tobacco upon life and health; by R. D. Mussey, M. D. Boston, 1836. From the Author.

A Catalogue of Plants and Shells, found near Milwaukee, on the shores of Lake Michigan; by J. A. Lapham. Two copies, one for Yale Nat. Hist. Society; from the author.

Address before the Alumni of Hanover College, Indiana; by M. A. H. Niles, A. M. From Prof. W. M. Dunn.

Providence Daily Journal, Vol. VIII, No. 141.

Connecticut Courant, Vol. IV, No. 50.

The Specie Circular—Speech of Mr. Webster, (of Mass.) From Hon. Abbott Lawrence.

Catalogue of Willoughby University, Lake Erie, Circular No. 4.

Catalogue of the Faculty and Students in the Medical School at Fairfield, Herkimer County, N. Y. 1836-37. From Dr. Mussey.

Catalogue of Books for 1837, chiefly published or imported by Hilliard, Gray & Co. Boston; from them.

Journal of the American Temperance Union, Nos. 1 and 2.

Temperance Recorder, No. 1.

A Compendium of Chemistry; by Robert Hare, M. D. Prof. of Chemistry, Univ. Penn. Third edition. From the Author.

Catalogue of Oberlin Institute, 1836–37.

First Annual Report of the Pennsylvania State Geologist. Two copies, from H. R. Trego, Esq. and E. Chauncey, Esq.

The Anti-Slavery Record, Vol. III. No. 1. E. Wright, Editor.

Correspondence of the American Bible Society, No. 7. From the Editor.

An Elementary Treatise on Astronomy, by John Gummere, A. M. Philadelphia, 1837. From the Author.

Mr. Cushing's Oration before the literary societies of Amherst College. From Mr. C. F. Smith.

Daily Buffalo Journal, with notices of the aurora and magnetism, Dec. 5, and Jan. 27 and 30, 1837. Mr. Haskins.

Boston Daily Advertiser, Vol. 42, Nos. 13,900 and 13,908, with notices of floating pumice stone on the coast of California.

New England Spectator, Boston, Vol. iii. No. 2. E. Thorp.

Gambier Observer, Vol. vii. No. 4.

Mr. Featherstonhaugh's Geological Report from Washington, by Green Bay and the Wisconsin Territory, to the Coteau de Prairie, &c. Two copies, one from Hon. S. Fowler, M. C. the other from Col. Abert.

Hints on the cultivation of the Mulberry, with some general observations on the production of Silk, by Lewis Tinelli, LL. D., C. L. Pavia, &c. The Author.

First Report on the Geological Survey of New York. Four copies, one to Am. Geol. Soc. one to Y. Col. Nat. Hist. Society. To the Editor, by E. Emmons, W. W. Mather and E. Briggs.

Another copy, from H. W. Taylor.

Report of Hon. Henry Clay on the address of certain British, and the petition of certain American authors on copyright. Hon. G. Tomlinson, S. U. States.

The Alabama Reporter, Vol. i. Nos. 4 and 5.

Columbia Telescope, Vol. xxiii. No. 7. From E. Adams, jr.

Genesee Farmer, Vol. vii. No. 5. Dr. Marsh, with meteorological observations.

Project and Act for a Statistical Society in New York. Ed. Williams.

Catalogue of the Medical College of S. C. Prof. C. U. Shepard.

Account of Saml. Raub, Jr.'s safety apparatus for steam boilers. Hon. G. Tomlinson, S. U. States.

Fourth Annual Report of the Trustees of the State Lunatic Hospital at Worcester. From the Superintendent, Dr. S. B. Woodward.

American Advocate of Peace, Hartford, Dec. 1836. F. Fellows, Editor.

Letter to Hon. W. H. Smith on School District Libraries, Genesee, 1837.

Laws of the University of Nashville, Tenn.

Catalogue of Indiana Theological Seminary and Hanover College, 1836-7. Prof. Dunn.

Jewett's Advertiser, Vol. ii. No. 10, and Vol. iii. No. 1 and 2. The Editor.

Milwaukee Advertiser, Vol. i. No. 29, with a map and notice of an ancient city in the Wisconsin Territory. J. A. Lapham.

The same in a Springfield paper, Illinois. J. W. Beach, Nashville, Illinois.

5th Annual Report of the Trustees of the New England Institution for the education of the blind—Boston, 1837. Dr. Saml. G. Howe.

Report of John L. Riddell, M. D. on a Geological Survey of Ohio. The Author.

Dr. Robley Dunglison's Address to the Medical Graduates of the Jefferson Medical College. The Author.

A second copy, from an unknown hand.

Annual Report of the Common Schools, Academies and Colleges of Pennsylvania, by Th. H. Burrowes, Superintendent.

First Report on the Geology of Maine, with an atlas of plates, by Dr. Charles T. Jackson. Two copies. The Author.

Summary of Meteorological Observations—last half of 1836—Lexington, Ky. By Dr. Robert Peters. The Author.

The Juvenile Lyceum, New Brunswick, N. J. Vol. i. Nos. 10 and 11.

FOREIGN.

Brighton Gazette and Lewes Observer. Nos. 822 and 825. From Dr. Mantell, Eng.

Brighton Herald, No. 1574, Feb. 18, 1837. The same.

Report addressed by the Royal Soc. of Northern Antiquaries to its British and American members. Copenhagen, 1836.

Annals of Electricity, Magnetism and Chemistry, conducted by William Sturgeon. London. Vol. i. No. 1, 1836. Oct. From the Author.

Researches on Heat. 2d series, 4to. By Prof. J. D. Forbes, Edinb. 1836. The Author.

On the application of Glass for metal balance springs in chronometers. From Messrs. Arnold & Dent, London.

Neues Jahrbuch sur Mineralogie, Geognosie, &c. 3 Nos. 1836. Prof. Leonhard & Bronn, Heidelberg, Germany.

A descriptive Catalogue of the Mantellian Museum, Brighton, Eng. 4th ed. 1836. Three copies. From Dr. Mantell.

Thoughts on a Pebble. London, 1836. Two copies. From Mr. W. B. D. Mantell.

Essay on the German Language and Literature. By G. F. Richardson, Esq. Brighton, Eng. From the Author.

A Letter to the School Masters and Governesses of England and Wales. By Sir Richard Phillips. London. From Dr. Mantell.

New Works and New Editions. Messrs. Longman & Co.

Proceedings of the Geol. Soc. of London. Vol. ii. No. 41. The Society.

Phillips' Aphorisms—a century of original ones.

The Mining Journal, &c. No. 63 to 71. Vol. iii. inclusive.

The same, No. 72 to 75, Vol. iv. The Editor.

Conjectures on the future effects of Locomotion by Steam. By Horace Smith, Esq. From Dr. G. Mantell.

Geology and Natural History of the Province of Kemaon, Calcutta, Bengal, 1835. By Asst. Surgeon McLelland. From the Author, through Otis, Broaders & Co. Boston, U. S.

L'Institut, Paris, Nos. 185 to 195 inclusive. 25th Nov. to Feb. 1837.

Bibliotheque Universelle, Geneva. No. 10. Oct. 1836.

Bulletin de la Société Geologique de France.

Tome vi. last part, feuilles 21—23.

Tome vii. three parts, feuilles 8 to 19. From the Society.

Annales de Chimie et de Physique. August and September, 1836.

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Acknowledgments to Correspondents.

A letter addressed to the editor, from Key West, under date of August 14, 1836, by Lt. Benj. Alvord, of the army, mentions Ellicott's account, as published in his journal, of the meteors, which appeared near the Florida Reef, on the night of the 12th and 13th of of Nov. 1796. A copy of the Boston Columbian Centinel, dated May 14, 1803, forwarded to the editor by Mr. A. Shearman, contains an interesting notice of a great shower of meteors at Richmond, in Virginia, a little before the date named above. These communications were handed to Prof. Olmsted, of Yale College, who is well known as an ardent and successful investigator of the phenomena of meteors, and he assures us that the facts alluded to above, were before known to him, and have been cited in the accounts already published.

Several communications intended for this number, came too late, and many more are in hand; most of them will be inserted, but perhaps not without some delay.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

ART. I.—*General Remarks on the Temperature of the Terrestrial Globe and the Planetary Spaces;* by Baron FOURIER.*

Translated from the French, by Mr. EBENEZER BURGESS, of Amherst College.

THE question of terrestrial temperature, one of the most remarkable and difficult in natural philosophy, involves very different elements which require to be considered in a general light. I have thought it would be useful to have condensed in a single essay, all the results of this theory. The analytical details here admitted, are found in works which I have already published. I was specially desirous of presenting to philosophers, in a concise table, a complete view of the phenomena and the mathematical relations which exist between them.

The heat of the earth is derived from three sources, which should first be distinctly mentioned.

1. The earth is heated by the solar rays; the unequal distribution of which causes diversities of climate.

---

* TO PROFESSOR SILLIMAN.

Dear Sir—Although it is several years since they were published in France, I have never met with a translation of any of Baron Fourier's able papers on the temperature of the globe, nor seen in the English language a full view of the important principles which they develop. I have, therefore, requested Mr. Ebenezer Burgess, a tutor in Amherst College, to make a translation from the 27th No. of the *Annales de Chimie et de Physique*, of an article of Fourier, in which he gives a summary of the results to which he has come on the subject, by the use of mathematical analysis. And should your views of the value of this paper correspond with my own, I hope you may find a place for it, even at this late day, in your Journal.
With much respect,

Amherst College, July 4th, 1836. EDWARD HITCHCOCK.

2. It partakes of the common temperature of the planetary spaces; being exposed to the radiations from the innumerable stars which surround the solar system.

3. The earth preserves in its interior a part of that primitive heat which it had at the time of the first formation of the planets.

We shall separately examine each of these three causes, and the phenomena which they produce. We will show, as clearly as we are able in the present state of the science, the principal features of these phenomena. For the purpose of giving a general idea of this great question, and showing at a glance the results of our researches, we present them in the following summary, which is in some measure a synoptic table of the contents of this article, and of several which have preceded it.

The solar system is situated in a region of the universe, every point of which has a common and constant temperature, determined by the rays of light and heat which proceed from the surrounding stars. This low temperature of the planetary space, is a little below that of the polar regions of the earth. The earth would have only the same temperature with the heavens, were it not for two causes which are concurring to heat it. One is the internal heat which it possessed at its formation, a part of which only is dissipated through the surface; the other is the continued action of the solar rays, which penetrate the whole mass, and produce at the surface, the diversities of climate.

The primitive heat of the globe has no longer any sensible effect upon the surface: but it may be very great as we approach the center. The temperature of the surface does not exceed by the thirtieth of a centesimal degree, ($\frac{1}{15}$° Fahrenheit,) the lowest state to which it can ever be reduced. At first it diminished very rapidly: but at present with the greatest slowness.

The observations heretofore collected seem to show that the temperature of different points of the same vertical line, is proportional to the depth, and that this increase of temperature, as we advance towards the center, is about one degree for every thirty or forty meters. Such a result supposes a very high internal temperature. It cannot proceed from the action of the sun's rays; and it is naturally explained by the heat which belonged to the earth at its formation.

This increase of temperature, of about one degree for thirty-two meters will not always remain the same. It gradually diminishes; but many ages must elapse before it can be reduced to half its present value.

If other causes hitherto unknown, can explain the same facts, and if there exist other sources of terrestrial heat, either general or accidental, they will be discovered by comparing the results of this theory with those of observation.

The rays of heat which are continually proceeding from the sun to the earth, produce upon its surface two very distinct effects: one is periodical, and reaches no farther than the exterior crust. The other is constant. It is observed at great depths, say thirty meters, from the surface. The temperature of these places undergoes no sensible change in the course of the year; it is fixed. But it is very different in different climates; it results from the continual action of the solar rays, and from the unequal exposure of different parts of the surface between the equator and the poles. We can determine the time which must pass before the effect of the sun's rays could produce that difference in climate which now exists. All these results agree with those of the dynamic theories which have proved to us the stability of the axis of the earth.

The periodical effects of the solar heat, arise from the diurnal or annual variations. This order of facts is explained exactly, and in all its details, by the theory. The comparison of the results with the observations will serve to measure the conducting power of those substances of which the crust of the globe is composed.

The pressure of the atmosphere and bodies of water, has the general effect to render the distribution of heat more uniform. In the ocean and in the lakes, the coldest particles, or rather those whose density is the greatest, are continually tending downwards, and the motion of heat depending on this cause is much more rapid than that which takes place in solid masses in consequence of their connecting power. The mathematical examination of this effect would require exact and numerous observations. These would enable us to understand how this internal motion prevents the internal heat of the globe from becoming sensible in deep waters.

Liquids are very poor conductors of heat; but they have, like aeriform media, the property of carrying it rapidly in certain directions. This is the same property which, combining with the centrifugal force, displaces and mingles all parts of the atmosphere as well as the ocean, and maintains in them regular and immense currents.

The interposition of the air very much modifies the effects of the heat upon the surface of the globe. The solar rays traversing the atmospheric strata which are condensed by their own weight, heat them very unequally: those which are rarest are likewise coldest, because they extinguish and absorb a smaller part of the rays. The heat of the sun, coming in the form of light, possesses the property of penetrating transparent solids or liquids, and loses this property entirely, when by communication with terrestrial bodies, it is turned into heat radiating without light.

This distinction of luminous and non-luminous heat, explains the elevation of temperature caused by transparent bodies. The mass of waters which cover a great part of the globe, and the ice of the polar regions, oppose a less obstacle to the admission of luminous heat, than to the heat without light, which returns in a contrary direction to open space. The pressure of the atmosphere produces an effect of the same kind: but an effect, which, in the present state of the theory, and from want of observations compared with each other, cannot be exactly defined. Whatever it may be, we cannot doubt that the effect which should be attributed to the impression of the solar rays upon a solid body of very large dimensions, by far surpasses that which would be observed in exposing a common thermometer to the same rays.

The radiation of the most elevated strata of the atmosphere, the cold of which is very intense and almost constant, has an influence upon all the meteorogical facts of our observation; it can be rendered more sensible by reflexion from the surface with concave mirrors. The presence of the clouds which intercept these rays, mitigates the cold of the nights.

We see that the surface of the terrestrial globe is placed between a solid mass, the central part of which may surpass that of matter heated to whiteness, and an immense girdle, whose temperature is below that requisite for the congelation of mercury.

All the preceding results can be applied to other planetary bodies. They can be considered as placed in a medium whose constant and common temperature is little below that of the terrestrial poles. This same temperature of the heavens is that of the surface of the most distant planets; for the impression of the rays of the sun, even when augmented by the disposition of the superficies, would be too feeble to occasion sensible effects; and we know by the condition of the terrestrial globe, that, in the planets whose formation cannot be less ancient, there exists upon the surface no longer any elevation of temperature to be attributed to internal heat.

It is equally probable, that in respect to most of the planets, the temperature of the poles is little above that of the surrounding space, with respect to the temperature which each of these bodies owes to the sun, it is not known; because it may depend on the pressure of an atmosphere and the condition of the surface. We can only approximate to the truth in assigning the mean temperature which the earth would have acquired situated in the place of the planet.

After this exposition, we shall examine successively, the different parts of this question. We would first make a remark which has a relation to all these parts, because it is founded upon the nature of differential equations of the motion of heat. It is this: the effects of each of the three causes we have mentioned, may be calculated separately, as if it had no connection with the others. It is sufficient afterwards to unite these partial effects: *ils se superposent librement comme les dernieres oscillations des corps.*

We shall describe in the first place the principal results of the prolonged action of the solar rays upon the terrestrial globe.

If a thermometer is placed at a considerable depth below the surface of the solid earth, forty meters for example, the instrument indicates a fixed temperature. This fact is observed in every part of the globe. This temperature of deep places is always the same in the same place; but it is not the same in different climates. It generally decreases as we advance towards the poles.

If we observe the temperature of points much nearer the surface of the earth, for example, at the depth of one, five, or ten meters, we see very different effects. The temperature varies during a single day or year. But we can suppose the crust or envelop in which these variations take place, to be removed, and consider the fixed temperatures of the points of the new superficies of the globe.

We can conceive that the state of the mass has varied continually in proportion to the heat received from the origin of heat itself. This variable state of internal temperature has changed by degrees, and has approached nearer and nearer to a final state, which is subject to no change. Then each point of the solid sphere has acquired, and preserves, a temperature, a fixed temperature, which depends only on the situation of the point itself.

The final state of the mass, the heat of which has penetrated all its parts, can very justly be compared to that of a vessel which receives by openings at the top, liquid from some constant source, and permits exactly an equal quantity to escape by orifices.

Thus the solar heat has accumulated in the interior of the globe and is there continually renewed. It penetrates the parts of the surface near the equator, and is dissipated through the polar regions. The first question of this kind which has been submitted to the calculus, is found in a memoir which I read to the French Institute, at the close of the year 1807, Art. 115, page 167. This article is deposited in the archives. I then took up this first question to exhibit a remarkable example of the application of the new theory exposed in the memoir; and to show how the analysis points out the tract followed by the solar heat in the interior of the earth.

If now we replace this exterior envelop of the earth, whose points are not sufficiently deep to have a fixed temperature, we remark an order of facts more compound, the complete expression of which is given by our analysis. At a moderate depth, as three or four meters, the temperature observed does not vary during each day, but the change is very perceptible in the course of a year; it varies and and falls alternately. The extent of these variations, that is, the difference between the *maximum* and *minimum* of temperature, is not the same at all depths; it is inversely as the distance from the surface. The different points of the same vertical line do not arrive at the same time at the extreme temperatures. The extent of the variations, the times of the year, which correspond to the greatest, to the mean, or to the least temperatures, change with the position of the point in the vertical line. There are the same quantities of heat which fall and rise alternately; all these values have a fixed relation between themselves, which are indicated by experiments and expressed distinctly by the analysis. The results observed are in accordance with those furnished by the theory; no phenomenon is more completely explained. The mean annual temperature of of any point whatever in the vertical line, that is, the mean value of all those which might be observed in the course of a year, at this point, is independent of the depth. It is the same for all points of the vertical, and consequently that which would be observed immediately below the surface; it is the fixed temperature which exists at great depths.

It is evident that in the enunciation of this proposition, we make no account of the internal heat of the globe, and those accessory causes which would modify this result in a particular place. Our principal object is to ascertain general phenomena. We have before remarked that the different effects can be separately considered.

We ought likewise to observe respecting all the numerical values mentioned in this memoir, that they are presented here only as examples of the calculus. The meteorological observations proper for furnishing the necessary data, those which would show the capacity for heat and the permeability of the substances which compose the globe, are too uncertain and too limited, to enable us, by the calculus to deduce accurate results. But we mention these numbers to show, how formulas ought to be applied: and however much they may differ from true results, these values are much more suitable for giving a correct idea of the phenomena, than general expressions without their numerical application.

In those parts of the crust nearest the surface, the thermometer rises and falls during each day. These diurnal variations cease to be sensible at the depth of two or three meters. Below this we can perceive only annual variations, and these again become insensible at a still greater depth.

If the rapidity of the motion of the earth around its axis were to be infinitely increased, and the same were supposed to take place respecting its motion round the sun, the diurnal and annual variations would no longer be observed, the points of the surface would have acquired and would preserve the fixed temperatures of places at a great depth. In general the depth which we must reach in order that the variations may become insensible, has a very simple ratio to the duration of the period which reproduces the same effects at the surface. This depth is exactly proportional to the square root of the period. It is for this reason that the diurnal variations penetrate only to one nineteenth of the depth at which the annual variations are observed. The question of a periodical motion of the solar heat was examined for the first time, and resolved in a separate paper, submitted to the French Institute in October, 1809. I again brought forward this solution in a paper submitted at the close of 1811, and printed in the collection of our memoirs.

The same theory furnishes the means of measuring the quantity of heat which in the course of a year determines the succession of the seasons.

The design of this example of the application of formulas is to show that there exists a necessary relation between the laws of periodical variation and the whole quantity of heat which effects this variation: so that this law being known by observations made in a given climate, we can determine the quantity of heat which penetrates the earth and returns into the air. Considering, therefore, a law similar to this, which is established of itself in the interior of the globe, I have obtained the following results.

In one eighth of a year after the temperature at the surface is raised to its mean value, the earth begins to be heated; the rays of the sun penetrate it during six months. Then the heat of the earth takes an opposite direction; it comes out and is dissipated in the air and external space. Now the quantity of heat which undergoes these variations in the course of a year is expressed by the calculus. If the crust of the earth was formed of a metallic substance of forged iron, (the substance which I have chosen for an example, after having measured the specific coefficients,) the heat which produces the succession of the seasons, would be for the climate of Paris, and for a square meter of surface, equivalent to what would melt a cylindrical column of ice, having for its base this square meter, and a height of about three meters and one tenth. Although the value of the coefficients for substances of which the globe is composed, has not as yet been measured, we can easily see that they would give a result much less than we have just mentioned. It is proportioned to the square root of the product of the capacity for heat, considered in relation to volume and the permeability.

We will now consider the second cause of terrestrial heat, which, as we think, resides in the planetary spaces. The temperature of this space exactly defined, is that which a thermometer would indicate, supposing the instrument placed in any part of the space occupied by the solar system, and the bodies which compose this system annihilated.

We shall give a detail of the principal facts from which we have ascertained the existence of this heat, peculiar to the planetary spaces, which is independent of the presence of the sun, and of the original heat which the earth has preserved. To obtain a knowledge of this singular phenomenon, it is necessary to ascertain what would be the thermometrical state of the terrestrial mass, if it received only the heat from the sun. To facilitate this enquiry we may at first leave the atmosphere out of the account. Now if there existed no cause sufficient to give the planetary spaces a common and constant temperature, that is, if the earth and all the bodies of the solar system, were placed in space deprived of all heat, the phenomena observed would be altogether contrary to what we now witness. The polar regions would be subject to an intense cold and the decrease of temperature from the equator to the poles would be incomparably more rapid and extended.

In this hypothesis of the absolute cold of space, if it is possible to conceive of it, all the effects of heat which we observe at the surface of the earth, should be attributed to the presence of the sun. The least variations in the distance of that body from the earth, would occasion very considerable changes of temperature. The interruption of day and night, would produce effects sudden and totally different from what we observe.

The surfaces of bodies, would be exposed all at once, at the commencement of night, to a cold of infinite intensity. Animals and vegetables could not resist the sudden and powerful change which would be produced at the rising of the sun.

The primitive heat preserved in the interior of the earth could not increase the external temperature of space, and would prevent none of the effects which we have just described; for we know with certainty, by theory and observation, that the effect of this central heat has long since become insensible at the surface, although it may be very great at a moderate depth. We conclude from these observations, and chiefly from the mathematical examination of the subject, that there exists a physical cause always present which modifies the temperature at the surface of the earth, and gives this planet a fundamental heat, which is both independent of the action of the sun and that internal heat preserved in its own center. This fixed temperature, which the earth receives from space, differs but little from that which is measured at the poles. It is necessarily less than that of the coldest regions; but in this comparison we ought to admit only accurate observations, and should not consider the accidental effects of a very intense cold which may be caused by evaporation, by violent winds, and extraordinary dilatation of air.

After ascertaining the existence of this fundamental temperature of space, without which the effects of heat observed upon the surface of our globe could not be explained, we proceed to remark, that the origin of this phenomenon, thus to call it, is evident. It is to be attributed to the radiation from all the bodies in the universe, whose light and heat can reach us; the stars visible to the naked eye, the innumerable multitude of telescopic stars or opaque bodies, which fill the universe, the atmospheres which surround these immense bodies, the rare matter disseminated through every part of space, concur in forming rays which penetrate every part of the planetary regions. We cannot conceive of the existence of such a system of luminous and heated bodies without admitting that any point of space whatever which contains these bodies acquires a fixed temperature.

The immense number of bodies compensates for the inequalities in their temperatures, and renders radiation sensible and uniform.

This temperature of space is not the same in different regions of the universe; but it does not vary in the regions in which are situated the planetary bodies; because the dimensions of this space are incomparably smaller than those distances which separate it from the radiating bodies; for example, in all points of the orbit of the earth this planet finds the same temperature.

It is the same with other planets of our system: they all equally participate in the common temperature, which is more or less augmented for each one of them, by the rays of the sun, according to the distance of the planet from that body. Respecting the inquiry what must be the temperature of each of the planets, the principles which must settle it, furnished by an exact theory, are as follows. The intensity and distribution of heat on the surface of these bodies results from the distance of the sun, the inclination of the axes of rotation to the orbit, and the state of the surface. It is very different even in its mean value, from what would be indicated by a thermometer insulated in the place of the planet, for the solid state, the very great dimensions, and doubtless the presence of an atmosphere and the nature of the surface, determine the mean value.

The original heat which has been preserved in the interior, has long since ceased to have a very sensible effect upon the surface. For the present state of the crust of the earth shows us that the primitive heat of the surface is almost entirely dissipated. From the constitution of the solar system it is very probable that the temperature of the poles of each planet, or at least of the greatest part of them, is little less than that of space. This polar temperature is the same for all these bodies, although their distances from the sun may be unequal.

We can determine with some degree of precision, the temperature which the earth would have acquired if situated in the place of each of the planets; but the temperature of the planets themselves, cannot be ascertained; for in order to that we must know the state of the surface and the atmosphere. However, this uncertainty no longer exists as to the bodies which are placed at the extremities of the solar system like the planet Uranus. The impression of the solar rays upon this planet is evidently insensible. The temperature of the surface differs therefore, very little from that of planetary spaces, or from that which is observed at the poles of our globe. We have made known this last result in a discourse recently delivered before the Academy. It is evident we can apply it only to the most distant planets. We know of no means of assigning with any precision the mean temperature of the other planetary bodies. The motion of the air and waters, the extent of the seas, the elevation and form of the surface, the effects of human industry and all the accidental changes of the earth's surface, modify the temperatures of each climate. The character of phenomena attributable to general causes exists: but the thermometrical effects observed at the surface are different from what they would be without the influence of accessory causes.

The motion of the waters and of the air, tends to modify the effects of heat and cold.

It renders their distribution more uniform, but it would be impossible for the atmosphere to supply the place of that universal cause which supports the common temperature of the planetary spaces; and if this cause did not exist, we should observe, notwithstanding the atmosphere and seas, an enormous difference between the temperatures of the equatorial and polar regions.

It is difficult to know how far the atmosphere influences the mean temperature of the globe; and in this examination we are no longer guided by a regular mathematical theory. It is to the celebrated traveller, M. de Saussure, that we are indebted for a capital experiment, which appears to throw some light on this question.

The experiment consists in exposing to the rays of the sun, a vessel covered with one or more plates of glass, very transparent, and placed at some distance one above the other. The interior of the vessel is furnished with a thick covering of black cork, proper for receiving and preserving heat. The heated air is contained in all parts, both in the interior of the vessel and in the spaces between the plates. Thermometers placed in the vessel itself and in the intervals above, mark the degree of heat in each space. This instrument was placed in the sun about noon, and the thermometer in the vessel was seen to rise to 70°, 80°, 100°, 110°, (Reaumur,) and upwards. The thermometers placed in the intervals between the glass plates indicated much lower degrees of heat, and the heat decreased from the bottom of the vessel to the highest interval.

The effect of solar heat upon air confined within transparent coverings, has long since been observed. The object of the apparatus we have just described, is to carry the acquired heat to its *maximum;* and especially to compare the effect of the solar ray upon very high mountains, with what is observed in plains below. This experiment is chiefly worthy of remark on account of the just and extensive inferences drawn from it by the inventor. It has been repeated several times at Paris and Edinburgh, and with analogous results.

The theory of the instrument is easily understood. It is sufficient to remark, 1st, that the acquired heat is concentrated, because it is not dissipated immediately by renewing the air; 2d, that the heat of the sun, has properties different from those of heat without light. The rays of that body are transmitted in considerable quantity through the glass plates into all the intervals, even to the bottom of the vessel. They heat the air and the partitions which contain it. Their heat thus communicated ceases to be luminous, and preserves only the properties of non-luminous radiating heat. In this state it cannot pass through the plates of glass covering the vessel.

It is accumulated more and more in the interval which is surrounded by substances of small conducting power, and the temperature rises till the heat flowing in, shall exactly equal that which is dissipated. This explanation might be verified, and the results made more apparent, by varying the conditions and employing colored or blackened glasses, and exhausting the air from the intervals which contain the thermometers. When this effect is examined by the calculus, results are obtained in exact accordance with those of observation. It is necessary to consider attentively this order of facts, and the results of the calculus when we would ascertain the influence of the atmosphere and waters upon the thermometrical state of our globe.

In short, if all the strata of air of which the atmosphere is formed, preserved their density with their transparency, and lost only the mobility which is peculiar to them, this mass of air, thus become solid, on being exposed to the rays of the sun, would produce an effect the same in kind with that we have just described. The heat, coming in the state of light to the solid earth, would lose all at once, and almost entirely, its power of passing through transparent solids: it would accumulate in the lower strata of the atmosphere, which would thus acquire very high temperatures. We should observe at the same time a diminution of the degree of acquired heat, as we go from the surface of the earth.

The mobility of the air, which is rapidly displaced in every direction, and which rises when heated, and the radiation of non-luminous heat into the air, diminish the intensity of the effects which would take place in a transparent and solid atmosphere, but do not entirely change their character. The decrease of heat in the higher regions of the air does not cease, and the temperature can be augmented by the interposition of the atmosphere, because heat in the state of light finds less resistance in penetrating the air, than in repassing into the air when converted into non-luminous heat. We shall now consider that peculiar heat which our globe had at the time of the formation of the planets, and which continues to be dissipated at the surface under the influence of the low temperature of the planetary space.

The opinion of an internal fire as a perpetual cause of many remarkable phenomena, has been renewed in every age of philosophy. The end we have in view at this time, and which the latest progress of mathematical science enables us to reach, is to ascertain exactly by what laws a solid sphere heated by a long immersion in a medium, would discharge that primitive heat if it were transported into a space of a constant temperature inferior to that of the first medium. The design of the experiment is, to ascertain if the present temperature of the surface of the globe can yet undergo any sensible changes. The form of the terrestrial spheroid, the regular order of the lower strata, made manifest by experiments with the pendulum, their density increasing with the depth, and divers other considerations, concur in proving that a heat of very great intensity has at some previous period penetrated every part of the globe. This heat is dissipated by radiation into surrounding space, which has a temperature much below that of the congelation of water. Now the mathematical expression for the law of cooling shows that the primitive heat contained in a spherical mass of as great dimensions as the earth, diminishes much more rapidly at the surface than in parts situated at a great depth. These latter preserve almost all their heat for an immense period of time. There can be no doubt respecting the truth of these results, because we have calculated these times for metallic substances, which have a greater conducting power than those of which the globe is composed.

But it is evident that theory alone can only teach us the laws to which phenomena are subject. It remains now to inquire whether in penetrating the earth, we find any indications of a central heat.

We must ascertain, for example, whether the temperature increases with the depth as we go below those points whose diurnal and annual variations have ceased to be sensible. Now all observations collected and examined by the most learned philosophers of our day, show us that such an increase actually exists. It has been estimated at about one degree for thirty or forty metres. The experiments with which we have lately entertained the Academy, relating to the heat of springs, confirm the results of preceding observations.

The object of the inquiry we propose, is to discover the certain consequences of this single fact, admitting it to be given by direct observation; and to prove that it determines, first, the situation of the source of heat, and, secondly, the excess of temperature which still exists at the surface.

It is easy to conclude, (and the same result is obtained from an exact analysis,) that the increase of temperature as we go towards the centre cannot be produced by a prolonged action of the sun's rays. The heat proceeding from that body is accumulated in the interior of the earth; but the progress has almost entirely ceased, and if the accumulation was still continued, we should observe that increase in a direction precisely contrary to what we have mentioned. The cause which gives to deep strata a higher temperature, is, therefore, an internal source of constant or variable heat, situated below where man has been able to penetrate. This cause raises the temperature of the surface above what it would have been from the simple action of the sun's rays. But this excess of temperature of the surface has become almost insensible. Of this we are assured, because there exists a mathematical ratio between the value of increase by metre and the quantity, by which the temperature of the surface still exceeds that which would be found, if the internal cause of which we are speaking did not exist. To measure the increase by unity of depth, is the same thing as to measure the excess of temperature at the surface.

In a globe of iron the increase of a thirtieth of a degree per metre, would only give a fourth degree of actual elevation of temperature at the surface. This elevation is in direct ratio to the conducting power of the substance of which the crust is formed, all other conditions remaining the same. Thus the excess of temperature, which the terrestrial surface has at present, in consequence of this internal source, is very small; it is probably below the thirtieth of a centesimal degree, ($\frac{1}{12}^{\circ}$ Fahrenheit.) We ought to remark that this last result can be applied to all suppositions which can be made upon the cause, whether it be regarded as local or universal, constant or variable.

When we examine all the observations relative to the figure of the earth attentively, and according to principles of dynamics, we cannot doubt that the earth received at its origin a very high temperature. On the other hand, thermometrical observations show that the actual distribution of heat in the crust of the earth, is precisely what it would be if the earth had been formed in a medium of very high temperature, and had afterwards been left gradually to cool. It is important to notice the agreement of these two kinds of observations.

The question of terrestrial temperature has always appeared to us as one of the most important inquiries relating to cosmogony; and we have had this principally in view in establishing the mathematical theory of heat. From the commencement of our researches we have been desirous of ascertaining the laws of internal temperature in a solid sphere, heated at first by immersion in a medium, and afterwards left to cool in a medium of lower temperature. The memoir of 1807, before cited, contains a complete solution of that question, which was never before examined.

We have therefore determined the variable state of a globe, of a substance whose specific qualities we know, by experiment, and which after being immersed for some time in a heated medium, is transported to a colder space. We have considered likewise the variable state of a sphere which, having been plunged successively and for some time in two or more media of different temperatures, should undergo a final cooling in a medium of constant temperature.

After having noticed the general consequences of the solution of that question, we have examined particularly the case in which the primitive temperature acquired in a heated medium, might become common to the whole mass. And supposing the solid sphere to be of very great dimensions, we have endeavored to ascertain the law of progressive diminution of temperature in those strata nearest the surface. If we apply the results of this analysis to our globe, to ascertain what would be the successive effects of a primitive formation like that we have just supposed: we find that the increase of a thirtieth of a degree per metre, considered as the resultant of central heat, has in former periods been much greater, and that this increase is now almost a constant quantity, since more than thirty thousand years must elapse before it would be reduced to half its present value.

Respecting the excess of temperature at the surface, it varies according to the same law. The quantity by which it diminishes each century, is equal to the present value divided by double the number of centuries which have elapsed since the cooling process commenced: and since the limit of this number is given by historical monuments, we conclude that, from the Greek school at Alexandria, till the present time, the temperature of the surface has not diminished, on this account, the three hundredth part of a degree, ($\frac{1}{500}$° Fahrenheit.) Here again we find that stability which the great phenomena of the universe every where present. This stability, furthermore, is a necessary result, and independent of the primitive state, since the present excess of temperature is extremely small, and will diminish for an infinite length of time.

The effect of the primitive heat which our globe still preserves, has become nearly insensible at the surface of the crust; but it becomes more sensible at accessible depths, since the temperature augments with the distance from the surface. This augmentation, considered by unity of measure, would not have the same value for depths very much greater. It diminishes with this depth; but the same theory shows that the excess of temperature, which is almost nothing at the surface, can become enormous at a distance of some thousands of metres, so that the heat of the intermediate strata would exceed by far that of substances heated to whiteness.

The course of centuries will produce great changes in these internal temperatures; but at the surface these changes are at an end, and the continual loss of internal heat cannot hereafter occasion any cooling of climate.

It is important to remark, that the mean temperature of any place may undergo, from other accessory causes, variations more sensible by far than those which are produced by the continued cooling of the globe.

The establishment and progress of human society, and the action of natural powers, may, in extensive regions, produce remarkable changes in the state of the surface, the distribution of the waters, and the great movements of the air. Such effects, in the course of some centuries, must produce variations in the mean temperature for such places; for the analytical expressions contain coefficients which are related to the state of the surface, and have a great influence on the temperature.

Although the effect of internal heat may be no longer sensible at the surface, the sum total of this heat which escapes in a given time, as in a year or a century, is measurable, and has been ascertained. That which escapes in a century through a square metre, and is dissipated in the celestial space, would melt a column of ice, of which the base should be a square metre, and height three metres.

This result is derived from a fundamental proposition, which can be applied to all questions relating to the motions of heat, and especially to that of terrestrial temperature. I allude to the differential equation, which expresses for each moment the state of surface. This equation, the truth of which is plain, and easily demonstrated, establishes a simple relation between the temperature of an element of the surface and the normal motion of heat. What renders this result of theory very important, and more valuable than any other for throwing light upon the questions which form the subject of this article, is, that it exists independent of the form and dimensions of bodies, and of the nature of the substances, whether homogeneous or not, of which the internal mass may be composed. The results of this equation are absolute: they are the same, whatever may have been the material constitution or original state of the globe.

We have published in the "*Annales de Chimie et de Physique,*" the abstract of a memoir, which has not yet been printed, and the object of which is to apply to the terrestrial globe the analyses of the motions of heat in a sphere or plane solid, of great dimensions. In that extract the principal formulas were exhibited, particularly those which express the variable state of a solid uniformly heated at a determinate and very great depth, or in its whole depth. If the original temperature, instead of being the same to a very great depth, results from successive immersions in several media, the consequences are not less simple or remarkable. But this case, and several others which we have considered, are comprised in the general expressions which have been mentioned.

After having explained separately the principles of the inquiry respecting the temperature of the earth, in order to form a correct idea of these phenomena united, we ought to give, in a general statement, all the effects we have just described.

The earth receives the rays of the sun, which penetrate its mass, and are converted into non-luminous heat: it likewise possesses an internal heat with which it was created, and which is continually dissipated at the surface: and lastly, the earth receives rays of light and heat from innumerable stars, in the midst of which is placed the solar system. These are three general causes which determine the temperature of the earth. The third, that is, the influence of the stars, is equivalent to the presence of an immense hollow sphere, with the earth in the center, the constant temperature of which should be a little below what would be observed in the polar regions.

We might, doubtless, suppose radiating heat to possess properties hitherto unknown, which might, in some way, take the place of this fundamental temperature, which we attribute to space. But in the present state of physical science, all known facts are naturally explained without having recourse to other properties than those derived from actual observation. It is sufficient to represent the planetary bodies as occupying a space, the temperature of which is constant. We have endeavored, therefore, to ascertain what this temperature ought to be, in order that the effects on the thermometer should be what we now observe. Now they would be entirely different if we were to admit an absolute cold in space: but if we progressively increase the common temperature of the girdle or hollow sphere which encloses this space, we should see effects produced similar to what we now witness. We can, therefore, affirm, that the actual phenomena are such as would be produced if radiation from the stars was giving this temperature to all points of the planetary space. The primitive internal heat which is not yet dissipated, produces now but a very slight effect upon the surface of the earth: it manifests itself by an increase of temperature at great depths. At still greater distances from the surface it may exceed the highest temperatures which have ever been measured.

The effect of the solar rays is periodical in the superficial strata of the terrestrial crust. It is fixed in all points of great depths. This fixed temperature of the internal parts is not the same for all points. It depends principally upon the latitude of the place.

The solar heat has accumulated in the interior of the globe, the state of which has become unchangeable. That which penetrates in the equatorial regions is exactly balanced by that which escapes at the parts around the poles. Thus the earth gives out to celestial space all the heat which it receives from the sun, and adds a part of what is peculiar to itself.

All the terrestrial effects of solar heat are modified by the interposition of the atmosphere and the presence of water. The great motions of these fluids render the distribution more uniform. The transparency of the waters appears to concur with that of the air in augmenting the degree of heat already acquired, because luminous heat flowing in, penetrates, with little difficulty, the interior of the mass, and non-luminous heat has more difficulty in finding its way out in a contrary direction.

The succession of the seasons is maintained by an immense quantity of solar heat, which oscillates in the crust of the earth, passing below the surface during one half of the year, and returning into the air in the other half. Nothing can contribute more to throw light upon this part of the inquiry than the experiments, the object of which is, to measure with precision the effects of the solar rays upon the earth's surface. For this reason, we heard with the greatest interest the reading of the memoir presented by Prof. Pouillet; and if in the course of this article we have not mentioned his experimental researches, it is simply from the wish not to anticipate the report which will soon be made.

I have united in this article all the principal elements of the analysis of terrestrial temperature. It is made up from the results of my researches long since given to the public. When I began the investigation of such questions there existed no mathematical theory of heat, and we might well have doubted that such a theory could be possible. Those memoirs and treatises in which I have established this theory, and which contain the exact solution of the fundamental questions, have been submitted and publicly read, or printed and analyzed in the "*Recueils Scientifiques*," of the last few years. The object of this last article is to invite attention to one of the most important questions of natural philosophy, and to present general views and results. It would be impossible to resolve all doubts connected with a subject so extensive; which comprises, besides the results of a new and different analysis, physical considerations very varied in their natures. Exact observations will hereafter be multiplied. The laws on which depends the motion of heat in liquids and air, will be studied. Perhaps other properties of radiating heat will be discovered, or causes which modify the temperatures of the globe. But all the principal laws of the motion of heat are known. This theory, which rests upon immutable foundations, constitutes a new branch of mathematical science. It is composed, at present, of differential equations of the motion of heat in solids and liquids, and of the integrals of these first equations, and theorems relative to the equilibrium of radiating heat.

These theories will be hereafter much farther extended, and nothing will contribute more to bring them to perfection than numerous series of exact experiments; for mathematical analysis can deduce from general and simple phenomena, the expressions of the laws of nature; but the application of these laws to very complicated effects, requires a long course of accurate observations.

Art. II.—*Account of an Excursion to Mount Katahdin, in Maine*; by J. W. Bailey, Acting Professor of Chemistry, &c. U.S. Military Academy, West Point.

TO PROFESSOR SILLIMAN.

Sir—During a short visit which I made this summer to Waterville, in Maine, my curiosity was excited by the accounts I read and heard concerning Mount Katahdin, the highest mountain in the State. Its elevation and isolated position, together with the traditionary legends of the Penobscot Indians, that Katahdin is the residence of evil spirits, have given to this mountain considerable local celebrity. It has, however, been visited by few white men, and of their observations no accurate accounts have been published. Not being aware of the proposed geological survey of the State, (which, since my return, I learn has been assigned to able hands,) and in hopes that by visiting this mountain some interesting geological and botanical observations might be made, I proposed to Prof. Keely of Waterville College an excursion, on which Prof. Barnes of the same institution promised to accompany us.

In this communication, the object of which is to give a sketch of our journey and observations, I have purposely entered into some details, which may appear too trivial for admission into a scientific journal, but I believe these will be useful, by giving to any persons who may wish to visit Katahdin some idea of the manner of life they may expect to lead, the preparations to be made, and the route to be pursued.

Having procured a light wagon, Mr. Keely and myself proceeded on Saturday, the 6th of August, for Bangor. Our route lay through Clinton, Dixmont and Hampden. The rock passed over this day was argillite or graywacke slate, divided into very thin, nearly vertical laminæ, slightly dipping to the southeast. The direction or bearing of the edges of the laminæ is almost invariably about northeast and southwest, subject however in some places to most singular contortions, the general direction being still preserved. This argillite is well exposed in the bed of the Kennebeck at Waterville, and at the beautiful falls in West Waterville. This day we saw it in the bed of the Sebasticook at Clinton, and observed it often on the road to Dixmont, where it rises to a considerable elevation, and forms part of the dividing ridge between the Kennebeck and Penobscot valleys. Over the slate is generally spread a deposit of bluish gray clay, much used in making bricks, and upon the clay a diluvial deposit of boulders, principally of granite. We stopped for the night at a tavern near Hampden, and the next morning rode through Bangor and Stillwater, to Orono or Old Town. In the Penobscot at Bangor, and all the way to Old Town, the slate was seen preserving all its usual characters. At Orono it forms both banks of the Penobscot, and continues eastward, but how far I had no means of determining.

At Old Town, it being Sunday, we remained through the day and until noon on Monday, awaiting the arrival of Prof. Barnes, who had promised to join us at this place. During our stay we visited the Indian island belonging to the miserable remnant of the Penobscot tribe. The greater part of the Indians were absent on a fishing expedition to the sea-coast. They have here a neat chapel, and several frame houses, besides huts. A Roman Catholic priest resides with them. We asked one of the Indians how he liked his priest; he answered, "Oh, middling!" On Monday at noon, as Mr. Barnes had not arrived, we went on without him, and proceeded on the left bank of the river, by a fine road, to the tavern at Piscataquis, where we found as good accommodations as could be desired. We were particularly struck during our ride with the great quantity of *Epilobium spicatum*, which is generally known in this state by the name of *Fire weed*, from the abundance in which it springs up in fields recently burned over. Near Old Town I observed beds of *Calla palustris* in flower. From a short distance above Old Town, we did not observe along the road any argillite *in situ*, although its occasional appearance, in loose masses, indicated its close proximity. At the Piscataquis Falls, it again appears *in situ*.

Tuesday Morning.—We set out early for Matawamkeag Point, and proceeded as far as Lincoln on the good state road; breakfasted at Lincoln, and then proceeded on the military road leading by Matawamkeag Point to Holton, to which place a mail stage runs three times a week. Along the road we found fine specimens of *Orchis blephariglottis*, and near Matawamkeag Point passed over argillite well exposed.

At "the Point" there is a tolerable tavern, where we left our horse and wagon, trunks, &c. and prepared for our march into the woods. As we had been informed that there was a settlement at Grand Falls, about twenty three miles from the Point, where we would be able to procure blankets, provisions, boat and guides, we took with us only a few indispensable articles of dress, and a book to preserve botanical specimens. Thus lightly laden, we commenced the most arduous part of our journey. Crossing the Matawamkeag by the fine bridge built at the expense of the United States, and bidding farewell to civilization, we plunged into the woods by a blind path, (if path it might be called,) which was scarcely passable, although we were on foot, it was so obstructed by fallen trees, tangled roots, bushes and mud holes. At first it led us to the bank of the Penobscot; along the left bank it then continues, generally at a short distance from the river. As we had no guides, we were often much at a loss what direction to take, as the true path is often crossed by "logging paths," made during winter by the "loggers," for the purpose of hauling their lumber to the river. Whenever we lost our way, we made for the river, and proceeded awhile along its banks, until progress became too difficult, when we again turned into the woods, and generally succeeded in finding our path at a short distance from shore.

The forest through which we passed consisted generally of a growth of white pine, *Pinus strobus;* hemlock, *P. Canadensis;* larch, *P. pendula*, Ait.; spruce, *P. nigra* and *P. alba;* cedar or arbor vitæ, *Thuja occidentalis;* beach, *Tagus ferruginea;* &c. with an under growth of moose-wood, *Acer striatum*, and hobble-bush, *Viburnum lantanoides.* Among the herbaceous plants, we found fine specimens of *Orchis orbiculata*, Pursh, *Orchis grandiflora, Goodyera pubescens, Neottia cernua, Aralia hispida, A. racemosa, Dalibarda repens, Monotropa uniflora, Pyrola secunda*, and *P. umbellata.*

Among the plants not in flower were great quantities of the following, viz. *Cornus Canadensis*, (known in Maine by the expressive name of *bunch berry*, from its beautiful bunches of scarlet berries; these berries are dry and insipid, but not unpleasant to eat;) the ivory berry, *Gaultheria hispidula* of Linnæus, of which Dr. Torrey has made a new genus; *Linnæa borealis*, *Streptopus roseus*, *S. distortus*, *Convallaria umbellulata*, *Panax quinquifolium*, *Coptis trifoliata*, *Tiarella cordifolia*, *Mitella prostrata*; and the following ferns, &c. were seen in fruit, viz.: *Polypodium dryopteris*, *P. connectile*, *Adiantum pedatum*, *Struthiopteris Pennsylvanica*, great quantities of *Pteris aquilina*; also *Lycopodium clavatum*, *L. complanatum*, *L. obscurum*, and *L. lucidulum*.

On the shore of the river I noticed the following plants growing abundantly, viz.: *Ranunculus repens*, *Campanula rotundifolia*, *Sagittaria sagittifolia*, and *Mimulus ringens*; also a very large specimen of *Orchis dilatata*.

We lost our way near Salmon stream, but after considerable labor effected a passage through the tangled bushes to the mouth of this creek, which we forded; after which we soon reached the first settlement above Matawamkeag Point, on this side of the river. Here we found a log cabin occupied by a family of Howards, who gave us a good supper and tolerable accommodations for the night. The Indian name of the settlement is Nickatow; its distance from "the Point" is about ten miles.

Wednesday, Aug. 10*th*.—This morning we proceeded to the next log hut on the same side of the river, and there crossed in a boat to the opposite side. I was much pleased by finding directly on landing great abundance of *Swertia deflexa*; I am not aware that this plant has been previously noticed as growing in New England. This locality is on the right bank of the Penobscot, just below the mouth of the East Branch, latitude about 45° 25′. The corolla of this plant is generally described as greenish yellow; I found, however, that before the ripening of the seed the corolla was dark blue, darkest on the spurs and shaded with green as in several of the Gentian tribe. The corolla does not become greenish yellow until the capsule has nearly ripened; but gradually increases in size and changes its hue until it finally withers, still adhering to the base of the ripened capsule. The latter when ripe is membranous, beaked, and splits half way to the base into two valves. In Dr. Beck's Botany I observe the remark, that this plant in drying turns black; this has not happened to my specimens, which retain their original color even better than is usual with dry plants. Our path lay next on the right bank of the river, and was fully as difficult as the one we had travelled upon the previous day. After going about six miles we arrived opposite "Dolby's," about six miles from Grand Falls. Here we found two log cabins, to which we went after crossing the river in a bateau belonging to one of them. After getting a miserable dinner we engaged two men to convey us in their boat to Grand Falls. We found the river very low, and had many opportunities of admiring the skill and coolness with which our boatmen managed their bateau, and forced it up rapids which at first seemed impassable. We stopped at the mouth of the Millinoket to fish for pickerel; while our boat lay here, I observed in the water great quantities of *Lobelia Dortmanna, Nymphæa odorata, Nuphar advena, Hydropeltis purpurea, Villarsia lacunosa, Eriocaulon pellucidum,* with stipes two or three *feet* long. The *E. pellucidum* is generally described as being but two or three *inches* in height; but the plants above referred to, as well as similar ones four feet long, which I have seen in ponds near Haverhill, Mass. do not appear to differ essentially from this species. The length of the stipe depends on the depth of water in which the plant grows. We also noticed here the leaves of a plant which I believe is *Sparganium natans,* Smith; these leaves were "long, floating, flat, and pellucid," about one fourth of an inch wide, and from eight to ten inches in length. It grows abundantly in all the upper lakes of the Penobscot. A short time after we reached the settlement at Grand Falls, we were agreeably surprised by the arrival of Prof. Barnes, who had set out from Matawamkeag Point in pursuit of us that morning, and performed on foot in one day the same distance for which we took part of two. We gave him a hearty welcome, and this evening determined upon our plan of proceeding to the mountain. We engaged two athletic "loggers" named Mac Astlin to act as guides and boatmen, and agreed to pay each two dollars per day for his services.

At Grand Falls, the only settlement consists of two log huts, occupied by persons engaged in logging. They cultivate but little ground, and have most of their supplies brought up the river in boats. In the smoky garret of one of these huts we passed the night, and rose early on *Thursday* to prepare for our journey. While waiting for our breakfast I was much pleased by discovering at this cabin—the very out-post of civilization in this direction—a well thumbed copy of Scott's Heart of Mid Lothian. "There's fame for you!"

Having each procured a blanket, a pound of pork and a pound of bread per day, a little tea and salt, and by a lucky thought, each taking a red flannel shirt, which afterwards proved very serviceable to us; we made our packs by means of our blankets, and then slinging them over our shoulders, we proceeded on the Portage or "Carrying Place," by the Grand Falls to reach our bateau, which was about three miles above. The appearance of our party as we filed through the woods, was very picturesque; our sturdy guide, Cyrus, led the van, having on his head a white felt hat, from which rains and time had long removed all stiffness, and which now formed a perfect cone, except where part of the brim was turned in over the forehead to give the eyes fair play. Over his shoulders was thrown an immense pack made of blankets, and containing provisions, &c., its color contrasting finely with his red flannel shirt. Around his waist was a broad leathern belt to which were buckled a couple of tin cups and a brass kettle. On one shoulder he bore his oars and paddles, on the other a frying pan, axe, &c. His brother followed, somewhat similarly equipped, carrying a fowling piece, &c., and we with our smaller packs, and some light articles, closed the procession.

On our way through the woods we again found the *Swertia deflexa*, and also passed over argillite in situ. This place, between Grand Falls and Quakish Lake, about three miles from the former, is the most northern point at which I have observed this rock.

When we launched our boat she was found to leak very badly, but we soon remedied this difficulty by scraping from her sides some of the superfluous pitch, which we placed upon her bottom; then by applying the heated frying pan the cracks were soon stopped, and we proceeded. Crossing the Quakish Lake and North Twin, we soon entered Lake Pemmidumkook; here we had a fine view of Katahdin, and could distinguish the various slides with which its sides are furrowed. At noon we went on shore to dine, and having made a fire at an old logging camp, we prepared our meal in campaign style, by each taking a large slice of fat pork, which we stuck upon sharpened sticks and then roasted until it was black. Pork thus cooked, with stale bread, and strong tea made in our brass kettle and swallowed without milk or sugar, formed our frugal fare, of which we partook with almost incredible relish. At this camp I was fortunate enough to find a pair of excellent moose skin moccasins, which were a great prize to me, as my boots were already worn through.

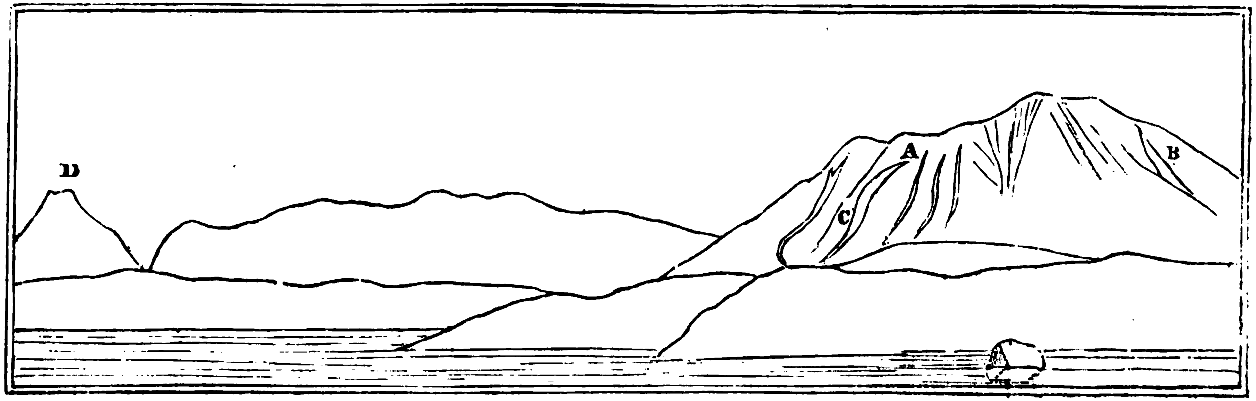
After dinner we embarked again, and proceeding by the Deep Cove and the Ambijeegis Lake and Falls, we stopped at night at the foot of the Passamagamet Falls, where, leaving Mr. Keely on the rocks to fish, the rest prepared for our night camp. Mr. Barnes and myself collected for our couch the fragrant boughs of the cedar, (*Thuja occidentalis,*) while our guides cut down bushes and pulled up their roots from the spot selected for an encampment. Our friend Cyrus in a few minutes chopped down a mighty hemlock, which fell with a tremendous crash ; its trunk was to serve for our back log, against which we soon had a fine blazing fire. Four stakes supporting cross pieces, over which were thrown a couple of blankets fastened together by wooden pegs, formed a very comfortable tent, under which we spread a soft carpet of twigs.

Mr. Keely appeared presently with a fine mess of white perch and chub, which when fried, furnished us a delicious meal. The stump of the hemlock served as our table and the clean chips as plates. The whole scene formed a picture worthy of the pencil of Weir. During the night it rained hard, but our blankets proved sufficient protection. After a good night's rest we went forward again the next morning, (Friday,) having first caught and cooked for our breakfast another fine mess of fish.

At all the falls which we had passed since leaving Grand Falls, we found the rocks to be loose boulders of granite ; but this morning we observed just below Debskoneegan Falls a large ledge of granite in situ. This is the most southern point where we had an opportunity of seeing it *in situ* during this journey. At these falls we were obliged to carry our boat a distance of about ninety eight rods, when we again launched her.

From Debskoneegan Lake the view of Katahdin is very fine. I have attempted in the accompanying sketch to give some idea of its outline. (See the fig.) The mountain on the right is Katahdin ; (A) the large western slide, and (B) the eastern. The mountain on the extreme left is Sugar Loaf; it bears a striking resemblance to a volcanic mountain, of which the remarkable depression in its summit represents the crater. We were unable to determine whether this apparent hollowing out of the summit was real, or an optical deception produced by the receding ridge. Between the two principal slides (A) and (B), the chief growth upon the mountain appeared to be very low deciduous trees. These we afterwards found to be white birch, (*Betula populifolia.*) The eastern and western extremities of the mountain beyond the above mentioned slides, presented the dark green color of the evergreen pines and furs. The summit and a considerable space below, bare of vegetation. On the lower part

Outline of *Mount Katahdin, as seen from Debskoneegan Lake.*



A, West Slide.—B, East Slide.—C, Camp.—D, Sugar Loaf.

of the mountain we observed an appearance indicating horizontal terraces.

After taking the annexed sketch, and examining the plants near the shore, among which I found *Potentilla fruticosa* growing abundantly, we continued our route and soon arrived at the Pockwockamus Falls, which presented a very wild and picturesque scene. It is an immense collection of fragments of granite, rounded and polished by the action of the current, which in many places has, by the attrition of the gravel and pebbles, worn circular cavities in the rocks.

Upon the rocks are piled, in wild confusion, a great quantity of logs, which have formed at these falls a "*jam*," which the loggers had not been able to loosen. We noticed several places where the rocks had been blasted to liberate the lumber. It was with much labor that we transported our baggage over these rocks, while our boatmen forced the empty boat up the falls. The next falls we arrived at are called Abawljacarmegas, where a fine ledge of granite of the best quality is well exposed in the bed of the river.

We arrived early in the afternoon at Hoyt's stream, where we hauled our boat on shore, turned her over, and deposited under the bottom the greater part of our provisions, our gun, frying pan, extra clothing, &c.; then, having made up our packs with one blanket each, and a short allowance of provisions for two days, we proceeded on foot for the mountain, from whose base we estimated our distance to be about three miles. Our guides were now upon ground entirely new to them, neither of them having ever ascended the the mountain. We directed our course towards the slide marked (A) in the drawing. Having no path to direct us, we found our journey exceedingly difficult. The first part of our way was over a ridge where the woods had been burned; here our principal annoyance was caused by a very small black fly, which our guides called "*minges*," and to which the Indians give the appropriate name of "*No-see-'ems.*" After leaving the "burnt woods," we descended into a dense cedar swamp, from which we extricated ourselves with much labor, and then soon struck upon a rapid mountain brook, which for the purity and transparency of its water, surpassed all I had ever beheld. We followed this stream a while, but finding that it was leading us from our course we left it and turned to the west, by doing which we soon arrived at the slide. Here a scene of wild confusion presented itself; masses of granite, shivered by their fall from above, lay scattered over the path of the slide; all traces of the original soil and vegetation were swept away, so that the denuded ledges of granite appeared in some places, while in others they were covered with great quantities of a coarse gravel, evidently produced by the crumbling of some of the coarse varieties of granite, much of which was seen in a state of partial disintegration. The flank of the mountain on which the slide is situated is covered with a low growth of white birch, (*Betula populifolia.*) Some small bushes of the same have sprung up in the path of the slide and in time will probably cover it.

At sunset we had ascended about one third of the height of the mountain, when finding the ascent very tiresome, we determined to encamp for the night. We selected for our camp a spot in the birch woods on the western edge of the slide, near which was a stream of excellent water. It was with much difficulty that we succeeded in making a small fire, our only fuel being the green trunks of the birch, and a few fragments of dead wood found in the slide. We felt very sensibly the want of the dry hemlock and cedar, which had so well served us for fuel the preceding evening. After supper we rolled ourselves up in our blankets, and with no canopy but the heavens, prepared for repose, for which the fatigues of the day had given us sufficient desire. The evening was clear, except a cloud which rested on the highest summit. During the evening some brilliant flashes of aurora borealis were seen.

Saturday, Aug. 13.—Our disappointment was very great this morning at finding ourselves surrounded by a drizzly mist, which threatened rain, and completely prevented our enjoying any view of the surrounding country. After waiting a while, in hopes of its clearing away, we commenced our ascent, placing ourselves abreast of each other that the stones which one might loosen should cause no injuries to the rest of the party. The slide near our encampment was about forty yards wide, narrowing very slowly towards the top. Soon after leaving our camp I discovered fragments of compact limestone containing distinct impressions of Terebratulæ. These were found in the path of the slide, but a slight examination convinced me that they were masses which had been deposited on the mountain by diluvial action. Mr. Keely informs that rolled masses of similar limestone have been found near Waterville College.

From the steepness of the mountain, the slipping of the loose stones and gravel, and the weight of our clothes drenched with the rain, our progress was slow, and very fatiguing; we toiled on, however, in spite of the rain, until we had reached a point about six hundred feet from the summit. By this time I became so much exhausted as to fear I would not be able to reach the summit, and have strength enough left to return to the boat that afternoon. Our time being limited, as well as our provisions, it was necessary that we should reach the boat that day; for fear therefore of detaining the party I determined very unwillingly not to exhaust my strength by ascending any higher. Had the day been fine there would have been more inducement to proceed; but we were enveloped in clouds, drenched with rain, and there was no prospect of the weather becoming such as to enable us to enjoy that view from the summit which is the principal inducement to reach it. Mr. Barnes with the two guides determined to proceed, while Mr. Keely and myself were to return to the camp and prepare a fire. Before descending, I examined the plants growing at the elevation which we had reached. I found the following in great abundance near the slide, viz.: *Ledum latifolium*, *Vaccinium Vitis Idæa*, *Vaccinium uliginosum*, and *Solidago virgaurea*, var. *alpina*. In the slide itself were large patches of *Potentilla tridentata*, and *Arenaria glabra*. (The *P. tridentata* is somewhat improperly called *Mountain potentilla;* it however flourishes within a few yards of the ocean, near the observatory at Portland.) We found also in descending, many bushes of *Ribes ringens*, whose berries, though ripe, were very nauseous at first; but my thirst made me persist in eating them, and I soon found them quite palatable. We examined the rocks in the slide while on our way to the camp, but found little of interest: fragments of shell limestone were not uncommon, besides which were many fragments of hornblende rock, graywacke, and amygdaloid. Some of the latter has a green paste resembling compact epidote; in this was once imbedded a substance which has decomposed, leaving the globular cavities which it once filled, nearly empty. The vesicular stone thus formed has a striking resemblance to a volcanic product. I also noticed many fragments of jasper of a fine red color. No indications of any ores were perceived.

When we arrived at our camp, we found our fire extinguished, and ascertained, much to our chagrin, that our friends had taken with them our only means of kindling one. The rain was increasing in violence, our only resource therefore, was to spread one blanket on the ground and another over it as a tent, by which we were partly sheltered from the storm. In about an hour we heard the merry shout of our comrades, who, thoroughly drenched, and much fatigued, soon arrived at camp. Mr. Barnes stated that the difficulty of the ascent increased greatly until he reached the ridge above the slide, along which he then proceeded without much trouble to the summit. On the very summit he found a fine bed of grass, and picked specimens of two plants, which I found to be *Vaccinium uliginosum* and *Empetrum nigrum,* both in fruit. He brought no specimens of the grass.

The summit rock, of which he brought down some specimens, is a reddish colored granite, containing small, well formed crystals of feldspar. It is stated in Williams's History of Maine, that on Katahdin, vegetation ceases a mile from the summit, and that the elevation is so great as to cause difficulty of breathing, as well as intense cold to be felt; Mr. Barnes contradicts this, having found vegetation on the summit, and not having perceived any great rarefaction of the air, or sensible reduction of temperature.

It is evident from this, that the height of this mountain has been greatly overrated. It has been variously estimated at from five thousand to six thousand four hundred feet above the level of the sea. It was our intention to have measured its height, but unfortunately we could not procure a mountain barometer either in Waterville or Bangor.

Before we descended from our camp, the clouds rose a little, so as to give us a fair view of some of the numerous lakes with which the region abounds. We could distinguish Millinoket, Debskoneegan, Pemmidumkook, &c. In descending, we passed numerous horizontal terraces which appeared to extend along the flanks of the mountain beyond the slide.

When we had descended nearly to the point where we had first entered the slide, we turned to the left, and pursued a southerly course; but in the endeavor to avoid the swamp which the day previous had caused us so much trouble, we lost our way and became entangled in several dense sphagnous swamps, in which was a thick growth of cedar, (*Thuja occidentalis,*) through which it was very difficult to effect a passage. Often we would completely lose sight of each other, and be obliged to shout to our guides to stop, for fear we might part company. The heavy rain in the morning had completely drenched the trees and bushes, so that every one we touched sent down upon us a shower, which soon wet us to the skin. Climbing over fallen trees, stumbling at tangled roots, now by main force making a passage through the bushes, and anon falling prostrate, as some rotten branch gave way, to which we had trusted for support, we at last reached the "burnt wood," with much less clothing upon us than when we began our journey. None of us, not even our guides, who were experienced woodsmen, were ever on so fatiguing a journey. Had we trusted entirely to our pocket compass, we might easily have returned to our boat by the same route by which we left it, but in the endeavor to avoid one swamp we got into a dozen, besides adding several miles to the length of our route. In the burnt wood we advanced with more ease, but before we reached the river we were again obliged to enter a difficult swamp. We finally struck the river a few rods above our boat, and were as much rejoiced to see it as was ever sea-sick traveller by beholding shore. The plants which I had an opportunity of noticing around the base of Katahdin during our hasty return, were the following, viz. *Monotropa uniflora*; *Pyrola secunda*; *Pyrola umbellata*; *Dalibarda repens*; *Cornus Canadensis*; *Epilobium spicatum*; *Convallaria trifolia*; *Gaultheria hispidula*; *G. repens*; *Streptopus roseus*; *S. distortus*; *Ledum latifolium*; *Kalmia angustifolia*, and *Sorbus Americana*. This last is sometimes called Round wood, because the stem is so perfect a cylinder.

On the shores of the Penobscot, near our landing place, I observed in the same abundance as at the lakes below, *Ranunculus repens*; *Potentilla fruticosa*; *Campanula rotundifolia*, and *Spartina cynosuroides*; to the latter our boatmen gave the name of "Blue Joints." In the stream were great quantities of *Lobelia Dortmanni*; *Eriocaulon pellucidum*, and *Sparganium natans*.

This night we encamped at the head of the Debskoneegan Carrying Place, where we found a small camp made of hemlock bark, which required but little adjusting to render it very comfortable. We made a large fire to dry our clothes and blankets, and then lay down for the night. In the morning (Sunday) I found myself suffering from a violent cold in my throat, which however had no serious consequences. Making a hasty breakfast, we again set out, eager to reach the Grand Falls before night. Whenever we were in still water we used both paddles and oars, and thus made rapid progress. We were particularly struck, during this day's journey, with the remarkable purity and transparency of the water, as well as the beauty and accuracy of the reflections from its surface. Every leaf and branch of the trees was distinguishable, and the rounded rocks, projecting above water, appeared like globular masses of some light substance afloat, and it was almost impossible to distinguish the dividing line between an object and its image.

A solemn stillness reigned upon these lakes, broken only by the sound of our paddles, the wild laugh of a loon, or cry of a white eagle which we occasionally startled from his perch on some lofty pine.

Near Hoyt's stream, however, we heard one "sound familiar to our ear;" it was the tinkling of cow bells, which we found were fastened to some fine oxen grazing on the islands in the stream. They belonged to Mr. Gibson, who has a camp farm at Sowadabunk, six miles above our landing place. We met him in his boat as we were descending the river; he was carrying up some men to cut the wild meadow hay, which is in great demand in this region during winter, when the woods are filled with "loggers" and their cattle.

Nothing worth recording occurred during the remainder of our journey to Grand Falls, where we arrived before sunset. The next morning, Monday, we engaged our faithful guides to transport us in their boat to Matawamkeag Point, where we arrived about three o'clock, P. M. with our relish for the comforts of civilization much heightened by our excursion. We returned, via Bangor, &c., to Waterville, and on calculating our expenses, found them to have been but twenty five dollars each, including the hire of the horse and wagon.

Before closing this article, I wish briefly to mention the places at which I have had an opportunity of observing the Argillite so often alluded to in the above article. During this journey it was the only rock seen *in situ*, from Waterville, east to Bangor, and thence north and north westerly to a point between Grand Falls and Quakish Lake. I observed it on an excursion made on foot to Mount Abraham in 1832, at the following places: from Waterville all the way to Norridgewock, where it forms the falls; and in Starks, Industry, Freeman, Kingsfield, and Anson. The only other rock observed, was a small hill of granite between Starks and Industry, and the granite forming the summit of Mount Abraham.

I have merely stated above the places where I have myself had an opportunity of examining the Argillite formation. It doubtless extends far beyond the limits of my observations, and as it is said to occur at Holton, it is not improbable that it traverses the whole state in a north easterly direction, and enters into New Brunswick. This formation appears very deficient in mineralogical interest. I have not seen in it any minerals, except quartz and sulphuret of iron. In some places it furnishes good roofing slate, and I have been informed that a vein of limestone occurs in the rocks near Ticonic Falls at Waterville, but I had not an opportunity of examining this place. I have called the formation Argillite from its *prevailing* character, although in some places it resembles talcose slate, and at others graywacke.

I think it worthy of remark, that the valley of the Kennebeck, from Waterville, as far north as I had an opportunity of observing during my visit in 1832 to Mount Abraham, is covered with boulders of granite, of so peculiar a character that they may perhaps some day be traced to their original position. These boulders differ from those observed on the Penobscot, by containing large imbedded crystals of white feldspar, which make the masses appear at a little distance as if they were covered with *broad chalk marks.* These crystals are generally about three inches long and one fourth of an inch wide. I have seen some, however, five inches long by four wide.

I hope soon to be able to send you an account of the botanical observations which I have made in the vicinity of Waterville: in the mean time I send this hasty article, hoping that the few facts it contains respecting the geology and botany of the regions visited, will be received with interest, on account of the few notices which have hitherto been published upon these departments of the natural history of Maine.

West Point, Aug. 31, 1836.

ART. III.—*Experiments on the Adhesion of Iron Spikes of various forms, when driven into different species of Timber;* by WALTER R. JOHNSON, Professor of Mechanics and Natural Philosophy in the Franklin Institute, Philadelphia.

IN reference to rail-road constructions, bridge-building, and several other useful applications in civil engineering, as well as in naval architecture, the adhesion of spikes, bolts and nails of various forms becomes an object of much practical importance. In regard to railroads, this matter is worthy of more attention than might at first sight be supposed. Owing to the high price of iron, the flat rail is often unavoidably adopted in preference to the edge rail; and whenever the speed of a train descending by gravity, or impelled with great velocity by the moving power, is to be suddenly checked by the brake, the friction of the periphery of the wheel on the rail, tends to drive the latter lengthwise, and thus to force all the spikes with which it is fastened into closer contact with the ends of the fibres which have been cut in driving them. If this partial or total dragging of the wheels along the rails take place, sometimes in one direction, and sometimes in the other, the spikes must be subjected to alternate impulses on opposite sides. Indeed, whenever the motive power depends on friction for its efficacy, as in the case of the common locomotive engine, there is a constant succession of these two opposite dragging forces, the engine constantly tending by its driving wheels to urge the rail backwards, and the train by an equal but more extensively distributed action tending to urge forward all the rails over which it is at the same moment passing. So decided is this influence, that on a rail road where the transportation is all in one direction, and where the cars descend by gravity, I have seen rails entirely detached, or remaining loosely connected but by a single spike, while others clearly indicated by the inclined position of their upper faces or heads, that they were pressed into an oblique or leaning position in the wooden sill.

This single case may serve to show the importance of attending to the character of the spikes used in similar constructions.

To determine some of the points relating to the forms of spikes, and the kind of timber into which they are driven, the following experiments were undertaken. They serve to show the relative economy of each form of spike, as well as its fitness for the purpose intended. The mode of executing the experiments was, to drive each spike to a certain distance above its cutting edge, into the edge of a piece of plank or scantling, and by means of a suitable apparatus, adapted to that purpose, to draw it out by a direct longitudinal strain. The machine employed for this purpose was the same as that which has been used for testing the strength of iron and copper, in experiments on the tenacity of materials employed in steam boilers. A strong band or strap of iron, connected with the weighing beam of that machine, held the piece of plank, and a clamped pincers, with a suitable jaw, for taking hold of the head and projecting part of the spike, was attached to the opposite part of the machine, which being tightened by a strong screw held the spike firmly, while the application of weights upon the long arm of the lever drew the timber away, and released the spike. Care was taken to cause the strain to pass through the axis of the spike, and, by a very gradual application of weights, to avoid surpassing that force which was just sufficient for its extraction.

The first experiment was upon one of Burden's patent square spikes, with a cutting edge, intended to be in all cases placed across the grain of the timber. This spike was .375 of an inch square, and was driven into a sound plank of seasoned New Jersey yellow pine, $3\frac{5}{8}$ inches. The force required to extract it was 2052 lbs. and the exact weight of the part driven into the wood was 866 grains troy.

The second trial was upon a flanched, grooved and swelled spike, having the grooves between two projecting wings or flanches, on the same sides as the faces of the cutting edge. The other two sides were planes, continuing to the head. A cross section of this spike, taken $1\frac{3}{4}$ inches above its edge or point, had the form of fig. 1. At $\frac{8}{10}$ of an inch, that is, where the flanches project least from the edge, or where the swell between them comes nearest to forming a perfect square, the form is as shown in fig. 2; the dotted line *e e*, in each figure, representing the direction of the cutting edge. Towards the head of this spike, the flanching and grooving is suppressed, and the form becomes a square. This experiment was made on the same piece of Jersey yellow pine as the first, and the weight required for extracting the spike was 1596 lbs. The weight of the part driven in was $708\frac{1}{4}$ grains. The cutting edge was irregular; the distance to which it was driven, was $3\frac{5}{8}$ inches, as in the first trial. To know the relative value of the two forms of spikes, we have but to divide the weight required for the extraction of each by the number of grains in the part which had been buried in the wood; thus, $2052 \div 866 = 2.37$, and $1596 \div 708.25 = 2.112$. Hence the plain spike had an advantage over the swelled and grooved one, in about the proportion 23 to 21. It should be mentioned also, that the plain spike was drawn out by a very gradual addition of force, whereas the force of 1596 lbs. drew the grooved spike immediately after its application. In the first trial, an attempt was made to detect any yielding or gradual retreat of the spike, before the final start, but none was observed.

Fig. 1.

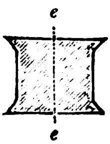
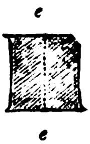


Fig. 2.



The third and fourth experiments were made with the same spikes respectively as the first and second; but instead of yellow pine, the timber employed was thoroughly seasoned white oak.

The plain spike driven $3\frac{3}{8}$ inches into that timber, required for its extraction a force of 3,910 lbs. and, as before, exhibited no signs of movement until the instant of starting, when it suddenly came out about $\frac{1}{4}$ of an inch, or as far as the range of motion and the elasticity of the machine would permit.

The flanched, swelled and grooved spike, driven $3\frac{3}{8}$ inches into another part of the same piece of plank, from which the plain one had been extracted, was drawn out with a force of 3,791 lbs. A slow motion to the extent of $\frac{1}{25}$ or $\frac{1}{20}$ of an inch was, in this trial, perceived to precede the starting of the spike; and was accompanied by a gradual protrusion of the fibres of the timber immediately around the iron. In these experiments, though the plain spike bore the greater absolute weights, yet when the weight of metal is considered, it is seen that the relative values of the two are 4.515 in the plain, and 5.354 in the grooved form. The various circumstances of the four preceding experiments are seen at a single view in the following table.

TABLE I.

No. of experiments.	Description of spike used.	Kind and condition of timber.	Breadth of spike. Inch.	Thickness of spike. Inch.	Depth to which it was driven. Inch.	Weight in grains of part driven in.	Force required to extract it in lbs. avoirdupois.	Ratio of extracting force to weight of spike.	Date.	REMARKS.
1	Burden's. plain sq. spike.	Season'd Jersey yellow pine.	.375	.375	3.375	866	2052	2.368	1835. Oct. 27.	Force gradually applied, no motion previous to the starting.
2	Flanched, grooved and swelled	Season'd Jersey yellow pine.	.375	.300	3.375	708	1596	2.254	"	Force applied at once.
3	Burden's plain.	Season'd white oak.	.375	.375	3.375	866	3910	4.515	"	Started suddenly.
4	Grooved and swelled.	Season'd white oak.	.375	.300	3.375	708	3791	5.354	"	Fibres protruded $\frac{1}{20}$ inch before spike drew out.

Hence it appears, that in yellow pine the grooved and swelled form was about 5 per cent. less advantageous than the plain, while in the seasoned oak the former was 18½ per cent. superior to the latter. It is also apparent that the advantage of seasoned oak over seasoned yellow pine for retaining spikes, is, by a comparison of experiments 1 and 3, as 1 to 1.9; and by a comparison of 2 and 4, it is as 1 to 2.37. In the preceding experiments the spikes were driven into the timber and immediately drawn out again. In the second series, the spikes were driven into their respective pieces of timber, and then soaked for a few days in water. The pieces into which the different spikes were driven, were as nearly alike as it was practicable to obtain them, being always cut from the same plank, avoiding knots, cracks, &c. The following table contains a view of the experiments after soaking the timber.

TABLE II.

Timber soaked after the spikes were driven.

No. of experiments.	Kind of spike used.	Kind and condition of timber.	Breadth of spike.	Thickness of spike.	Depth to which it was driven.	Weight in grains of the part inserted.	Force to extract the spike in lbs.	Ratio of the extracting force to the wt. of spike.	Date.
			Inch	Inch	Inch				
1	Swelled and grooved.	Chestnut unseasoned.	.375	.300	3.5	806.	1710.	2.121	1835 DEC. 3
2	" "	Yellow pine seasoned.	.375	.300	3.5	806.	1668.	2.069	"
3	" "	Hemlock partly season'd	.375	.300	3.5	806.	1738.	2.156	"
4	" "	White oak seasoned.	.375	.300	3.5	806.	3373.	4.184	"
5	" "	Locust partly seasoned.	.375	.300	3.5	806.	4902.	6.081	"
6	Swelled and grooved, the swell filed away.	Chestnut unseasoned.	.390	.300	3.5	759.	1852.5	2.440	"
7	" "	Seasoned yellow pine.	.390	.300	3.5	759.	1767.	2.328	"
8	" "	Hemlock partly season'd	.390	.300	3.5	759.	1296.8	1.576	"
9	Plain spike, filed lengthwise.	Chestnut unseasoned.	.400	.394	3.625	933.5	1790.	1.810	"
10	" " "	Hemlock partly season'd	.400	.394	3.5	933.5	1638.75	1.755	"
11	" " "	Locust partly seasoned.	.400	.394	3.5	933.5	3990.	4.167	"
12	" " "	" " "	.400	.394	3.5	933.5	4332.	4.640	"
13	Grooved and notched, or serrated.	White oak.	.392	.315	3.675	759.	2622.	3.454	"
14	Burden's patent.	" "	.339	.329	3.625	639.	2152.	3.367	"

REMARKS.

Experiment No. 1.—In this and the four following, the thickness of the spike is that at the bottom of the grooves.

Experiment No. 4.—The oak used in this experiment was firmer than that employed in the first series.

Experiment No. 5.—The timber had been slightly split by the driving of this spike.

Experiment No. 6.—The flanches remained after filing out the swelled part of the original form.

Experiment No. 12.—Timber slightly split in driving the spike.

The first five of the preceding experiments show that with a spike of given form, and driven a certain distance into different timbers, the order of retentiveness, beginning with the highest, is as follows: 1, locust; 2, white oak; 3, hemlock; 4, unseasoned chestnut; 5, yellow pine. From the 6th, 7th and 8th experiments, we see that chestnut is still above yellow pine, but that hemlock is inferior to both. By the 9th and 10th, it also appears that hemlock is still to be placed below chestnut. Comparing the 1st experiment in this table with the 6th, and the 2nd with the 7th, we perceive that the swell towards the point of the spike, was so far from being an advantage to it, that it in fact rendered the spike less retentive than when that swelled part had been removed; so that, even could this form have been produced without any increase in the weight of the spike, it would still have been less advantageous than the simple groove without the swell: but when it is considered that the swell added 47 grs. $(=806-759)$ to the weight, it is evident that the groove alone has a decided advantage over the other form. By the trials in unseasoned chestnut, (Nos. 1 and 6.) this advantage is 15 per cent.: thus $\frac{2440-2121}{2121}=15$; and by those on yellow pine, (Nos. 2 and 7,) it is $\frac{2328-2069}{2069}=12.5$ per cent. In fact, after the ends of the fibres have once been thrust apart by the thick part of the swell, it is evident that when they come opposite to the cavity above the swell they must lose some portion of their power to press the spike and produce the retaining force of friction; this force must then depend for its production on the action of those fibres of the wood which are opposite to the swelled portion, or between it and the point of the spikes.

In the next series of experiments, it was attempted to ascertain the relation between forms more diversified than had hitherto been employed.

As it is evident that the total retentiveness of the wood must depend, in a considerable degree, upon the number of fibres which are longitudinally compressed by the spike, it was inferred, that on the area of the two faces, which in driving the spike are placed against the ends of the fibres, must in a great measure depend the retention of the spike. In this series, four kinds of wood and ten forms of spikes were employed.

A comparison of the results given in the following table, will show what order those forms would possess among themselves, in point of retentiveness, as well as the advantages of the respective species of timber into which they were severally driven.

TABLE III.

Spikes of various forms—timber of different kinds.

No. of Experiments.	Kind of spike used.	Kind and condition of timber.	Breadth of spike. Inch.	Thickness of spike. Inch.	Area of two faces. Sq. in.	Depth to which driven. Inch.	Weight of parts inserted. Grs.	Force to extract spike. Lbs.	Ratio of force to weight of spike.	Date.
1	Straight square.	Chestnut unseason'd.	.405	.402	2.83	3.5	942	1995	2.116	1835. Dec. 4
2	Burden's patent.	"	.373	.381	2.64	3.5	866	1873	2.162	Dec. 8.
3	Broad flat.	"	.539	.288	3.77	3.5	898	2394	2.663	Dec. 4.
4	Narrow flat.	"	.390	.253	2.73	3.5	566	2223	3.927	Dec. 8.
5	Straight square.	White oak thoroughly seasoned.	.405	.402	2.83	3.5	942	3990	4.129	Dec. 7.
6	Broad flat.	"	.539	.288	3.77	3.5	898	5130	5.712	"
7	Narrow flat.	"	.390	.253	2.73	3.5	566	3990	7.049	"
8	Burden's patent.	"	.373	.384	2.64	3.5	866	3905	4.509	"
9	Cylindrical, with cutting edge.	"	.485	Diam.		3.5	1211	3876	3.200	"
10	Grooved and swelled.	"	.375	.375	2.60	3.5	806	3727	4.624	"
11	Grooved, but not swelled.	"	.375	.375	.260	3.5	759	4247	5.662	"
12	Grooved, and bottom of grooves serrated.	"	.375	.375	.260	2.5	500	2650	5.300	"
13	Square.	Locust seasoned three years.	.405	.402	2.83	3.5	942	5967	6.334	Dec. 8.
14	Broad flat.	"	.539	.285	3.77	3.5	898	7040	7.839	"
15	Narrow flat.	"	.390	.253	2.73	3.5	566	5273	9.316	"
16	Cylindrical, pointed with 15 grooves filed longitudinally from the point upwards.	Ash seasoned.	.500	Diam.		3.5	929	2052	2.208	1836. Jan. 4.
17	"	"	.500	"		3.5	929	2309	2.507	"
18	Plain, cylindrical, pointed, scale not removed.	"	.500	"		3.5	1015	2451	2.414	"

REMARKS.

Experiment No. 10.—The measures in this and the two following cases were taken outside the flanches.

Experiment No. 12.—The weight of the part inserted is given by estimation in this experiment.

Experiment No. 16.—In this and the two following experiments, the spikes were driven into the timber in the direction of the length of the fibres.

The above table furnishes three sets of comparisons for deducing the relative retaining powers of green chestnut, thoroughly seasoned oak, and equally seasoned locust. Thus the weight which in those three cases drew the square spike from chestnut, was 1995; and that which extracted the broad flat one 2394; and that which drew the narrow flat one from the same timber was 2223. The sum of these is 6612. The sum of the three numbers for the same three spikes used with oak, was by experiments 5, 6, and 7, 13110; and the sum of the three in locust, by experiments 13, 14, and 15, is 18280; these three numbers have to each other the relation of 1, 2, and 2¾; from which we infer that oak is almost precisely *twice*, and locust 2¾ times as retentive as unseasoned chestnut. By comparing together the results of experiments 1 and 2, it will be seen that the weights required for extracting the two spikes respectively, are more nearly proportional to the breadth than to either the thicknesses, or the weights of the spikes. For the spike with a breadth of .405 inch and a thickness of .402, required 1995 lbs. for its removal, while that which had a breadth of .375 inch took 1873 lbs. Now .373 : 405 : : 1073 : 2033 for the calculated retentiveness, instead of 1995, as given by experiments;—a difference of only +38 lbs. between the observed and calculated results. Calculating the retention by the *weights* of the respective spikes, we should have 866 : 942 : : 1873 : 2987, or a difference of 42 lbs. while using the thickness alone, we obtain .384 : 402 : : 1873 : 1960, a difference of an opposite kind of 35 lbs. from the observed result, the greater thickness yielding the less retentive power. This correspondence between the breadths and the extracting weights becomes still more apparent when we compare the third, and especially the fourth with the second experiment. Thus for the broad flat spike, (3d Ex.)—compared with experiment 2, we obtain

By breadths, .373 : 539 : : 1873 : 2701, instead of 2394, diff. + 307
“ weights, .866 : 898 : : 1873 : 1942, “ “ “ - 452
“ thicknesses, .384 : 288 : : 1873 : 1379, “ “ “ - 1015

and for the thinner and lighter spike, (Ex. 4th.)—compared with the same,

By breadths, .373 : 390 : : 1873 : 1958, instead of 2223, observed diff. - 265
“ weights, .866 : 566 : : 1873 : 1224, “ “ “ “ - 999
“ thicknesses, .384 : 253 : : 1873 : 1234, “ “ “ “ - 989

Nearly the same conclusions would result from a comparison of those trials, which were made on seasoned white oak and locust. Indeed, it appears that with a given breadth on the face of the spike, a diminution of thickness is sometimes a positive advantage to the retentiveness of the timber; for in white oak, the spike which had a breadth of only .390, required as much force to extract it, as one of which the breadth was .405, though the thickness of the former was but .253, while that of the latter was .402; and on chestnut, the thinner, narrower, and lighter spike, required absolutely more force to withdraw it than the other. This leads us to notice the different kinds of action of the respective spikes on timber of various kinds. In the softer and more spongy kinds of wood, the fibres instead of being forced back longitudinally and condensed upon themselves, are, by driving a thick, and especially a rather obtusely pointed spike, folded in masses backward and downward so as to leave in certain parts the *faces* of the grains of the timber in contact with the surface of the metal.

That the view just presented is correct, seems also probable from what was observed in the case of the swelled spike. For while the grooved but unswelled one, driven into chestnut timber, (table II. Ex. 6,) required 1852 lbs. to extract it, the grooved and swelled spike, (Ex. 1, same table,) took but 1710 lbs. And in table III. Ex. 11, we find the swelled spike drawn from white oak by 3727 lbs. and the grooved but not swelled one, Ex. 12, requiring 4247. Hence it appears to be necessary, in order to obtain the greatest effect, that the fibres of the wood should press the face as nearly as possible in their longitudinal direction and with equal intensities throughout the whole length of the spike. Arranging the spikes according to the order of their ratios of retention to weight, as given by the experiments in table III, from five to twelve inclusive, we have the following:

1.	*Narrow flat spike,* with a ratio of . .	7.049
2.	*Wide* " " " " " . .	5.712
3.	*Grooved but not swelled,* " " . .	5.662
4.	*Grooved and notched,* " " . .	5.300
5.	*Grooved and swelled,* " " . .	4.624
6.	*Burden's patent,* " " " . .	4.509
7.	*Square hammered,* " " " . .	4.129
8.	*Plain cylindrical,* " " " . .	3.200

Experiments 16, 17 and 18, of the same table, were made by driving the spikes which were cylindrical with conical points into the timber endwise of the grain. This method of comparing two forms, the one grooved and the other plain, was adopted on account of the extreme liability of the timber to be split by driving spikes of these forms *across* the direction of the fibres. It was observed that on drawing these spikes, the holes were almost perfectly square. This resulted from the position of the rings of annual growth and the greater elasticity in some directions than in others. It is probable that if the filed grooves in experiments 16 and 17 had been covered with a scale of oxide, as was the case with the plain spike used in experiment 18, the former would have given a result somewhat higher.

When holes are drilled into stone blocks and afterwards plugged with timber to receive spikes in fastening on the chairs of edge rails, the method of experimenting just described finds an application, and it is probable that in such cases the grooved cylinder with a conical grooved point, may prove advantageous.

A few experiments were made to determine the effect of driving to different depths, on the total amount of retention. For this purpose two different spikes were selected, viz. the square hand-wrought spike, the section of which was .405 × .402, and the wide flat one of which the section was .539 × .288. They were respectively driven to a certain depth into unseasoned chestnut, and then subjected to a force just sufficient to start them. This force was noted, and the spike was immediately driven down one inch deeper than before, and the force again applied. All my experiments proved that when a spike is once started, the force required for its final extraction is much less than that which produced the first movement. This is readily accounted for on the principle that as the wedge-shaped point was from half an inch to an inch in length; and as this, on the starting back of the spike a very little distance, became mostly relieved from the pressure of the fibres, all that part of the retention which had been due to the wedge-shaped portion of the spike was at once destroyed. The following table will show, however, that the mere starting of the spike with parallel faces does not essentially diminish the retention, when again driven into the timber to a greater depth than before. But when a bar of iron is spiked upon wood, if the spike be driven down until the bar compresses the wood to a great degree, the recoil of the latter may become so great as to start back the spike a short distance after the last blow has been given. In this case a great diminution in the useful effect will be the consequence. This shows that a limit may exist to the force which we should apply in urging down spikes or bolts destined to fasten materials together.

TABLE IV.

Spikes driven to different depths.

No. of the Experiments.	Form of spike.	Kind and condition of timber.	Breadth of spike.	Thickness of spike.	Area of the two faces pressing the ends of fibres.	Depth to which spike was driv'n.	Weight of the part inserted.	Force to extract the spike.	Ratio of force to weight of spike.	Date.
					sq. in.	inches.	grs.			1835.
1	square not filed.	chesnut unseasoned.	.405	.402	.7695	1.9	483	1183	2.428	Dec. 4.
2	" " "	"	"	"	1.1745	2.9	789	1995	2.528	"
3	" " "	"	"	"	1.5795	3.9	1095	2565	2.342	"
4	Broad flat.	"	.539	.288	.9702	1.8	442	1525	3.457	"
5	" "	"	"	"	1.5092	2.8	745	2594	3.482	"

By comparing experiments 1 and 4 together, it will be found that weight for weight, the flat spike had when driven 1.8 inches, an advantage of 42.3 per cent. over the square one; and by a like comparison of experiments 2 and 5, it is evident the former had a superiority of 37.7 per cent. As the spike when driven in only 1.9 inches had a much less proportion of its parallel faces exposed to the reaction of the fibres and a greater proportion of the wedge-shaped point, it is reasonable to expect that the retention would not correspond precisely with the lengths inserted. It will be understood that when we speak of *cutting edges* and the wedge-shaped portion of spikes, whether square, flat, or cylindrical, the direction of the cutting edges is always across the fibre or grain of the timber. It must be evident that the wedge-shaped part may be so acute, as to correspond nearly with two parallel faces, in which case, the tendency to retreat from the lateral pressures is small; and the pressures themselves, increasing from the point upwards to where the spike is thickest, the total efficiency of a given length may be as great as that of an equal length of the parallel faces, and even greater, provided the thickness of the spike be so considerable as in driving it to produce much crushing and irregular folding of the fibres of the timber. If, on the other hand, the edge be very blunt, the tendency to recoil may be such as to diminish the adhesion, and in this case the effect of the wedge shape is negative. In the other it may be positive.*

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* The following formula may represent the several experiments; $R=lf\pm c$, in which R is the observed retention; $l=$ the length in inches of the part inserted; $f=$ the force of retention on one inch of the parallel faces, and $c=$ the difference between the retention of a parallel portion of the spike, and of an equal length of the converging faces near the point. The sign of ambiguity arises from the cause above explained.

The *first*, *second* and *third* experiments indicate, in the tenth column of the preceding table, that beyond a certain limit the ratio of *weight of metal* to extracting force begins to diminish, showing that it would be more economical to increase the number rather than the length of the spikes, for producing a given effect in fastening materials together. In this case, also, it will be perceived, that the adhesion has a much closer relation to the areas of the compressing faces of the spikes, than to their weights. For three of the experiments this ratio may be regarded as identical, and dividing, for each of the five experiments, the observed retention by the area of the two faces opposed to the ends of the fibres, we get a mean result, which proves that the absolute retaining power of unseasoned chestnut, on square or flat spikes of from 1.8 to 3.9 inches in length, is about 813 lbs. for every square inch of those faces which condense longitudinally the fibres of the timber.

Art. IV.—*Remarks on the Natural order Cycadeæ, with a description of the ovula and seeds of Cycas revoluta, Willd.;* by A. J. Downing.

[Read before the Lyceum of Natural History, New York, Oct. 17, 1836.]

Cycas revoluta, figured in the accompanying plate, (Plate I.) belongs to a genus comprising but four other known species, which together with *Zamia* constitute the *Cycadeæ*, one of the smallest but most interesting orders in the whole vegetable kingdom. Their singular structure and manner of growth, their simple cylindrical stems and crowning tufts of foliage, like some of the Palms, and their commonly gyrate vernation, like that of most Ferns, as well as their anomalous inflorescence and fructification, have rendered them objects alike of the greatest interest and perplexity to the learned botanists who have examined them.

Cycas circinalis, Willd., a native of Malabar and Japan, seems to have been the first species discovered, having been described by Rheede, as early as 1682.* Rumphius,† in 1741, figured and described it under the name of *Olus calappoides:* he remarks its resemblance to the arborescent Ferns, and thinks it might with propriety be called *Osmunda arborescens.* Linnæus, who first gave the genus its present name, seems, from the imperfect manner in which its structure was known in his time, to have been greatly at a loss where to place it; for we find it first arranged by him among the Palms, and afterwards with the Ferns. It was not until the year 1807, after the suggestions of Ventenat, that the natural order of Cycadeæ was established, it having been first characterized by the elder Richard, in Persoon's Synopsis Plantarum.

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* Hort. Malab. vol. iii, p. 9.

† Herb. Amboiense, vol. i, p. 87.

C. revoluta, though of late years well known in the fine living collections of England and the Continent, appears to have produced its flowers but rarely. The description and plate,* by Sir J. E. Smith, taken from a specimen which flowered in the hot-houses of the Bishop of Winchester in 1779, and the plant at Wentworth House, mentioned as being in a state of inflorescence in 1829, by Sir Wm. J. Hooker, and figured in the Botanical Magazine,† (both of which notices are now considered imperfect in their views of the structure of the stem and seeds,) are all that have come under our observation.

In Japan, the native country of this species, its curious fructification is, we believe, renewed annually; and the Japanese, who make considerable plantations of it around their houses, are said to eat the seeds and extract an inferior kind of sago from the pith or central part of the stem; whence it has received the name of Sago Palm, although the true sago of the shops is the production of a very different plant, the *Sagus Rumphii*, Willd., which is a true Palm. According to Dr. Hamilton,‡ the flour used by the poorer natives of Malabar, called *Indum Podi*, is prepared from the seeds of a species of Cycas, dried and beaten in a mortar.

For a long time, those who examined this group of plants seem to have been more occupied with their external appearance, as exhibited in the fine pinnated foliage and simple trunk of Cycas, than with any minute investigation of the real nature of the reproductive organs. When, however, the plants of this order were attentively examined as to their germination, their mode of inflorescence, and especially as to the nature of those singular bodies denominated the female flowers, new light was thrown upon their characters and affinities. To that learned and most accurate botanist, Robert Brown, we are mainly indebted for those views which explain the true structure of Cycadeæ, and establish an intimate relationship with the apparently very different group of plants, known under the name of Coniferæ. These views were presented to the world in a paper read before the Linnæan Society of London, in 1825, on the "structure of the female flowers in Cycadeæ and Coniferæ."* The elder Richard, in his admirable "*Mémoire sur les Conifères et les Cycadées,*" prepared about the same time, and published afterwards by his son, had indeed, with great ingenuity, established the affinity between Cycadeæ and Coniferæ; but his views respecting the female flower and seed of both these tribes differ widely from those of Brown, and are now generally admitted by the first botanists to be erroneous. The female flower of these orders consists, according to Richard, of a monosepalous perianth or calyx, enveloping or adhering to an unilocular ovarium, which contains the true seed. He considers the aperture at the apex of the outer coat to be the style, and the projecting point of the second, the stigma. Brown, on the contrary, suggested that the calyx, &c. of Richard, are but the membranes of the ovula, and in the mature state the integuments of the seed; in short, that the bodies called by Richard and other writers the female flowers, are *naked ovula*, borne upon the margins of a contracted leaf, which last may be considered as an imperfect and open ovarium. The impregnation he supposed to take place through the foramen of the ovulum, (the perforated stigma of Richard,) there being (contrary to the usual structure in phenogamous plants) no style or stigma through which the pollen can find its way to that body. These ideas, so startling and paradoxical at first sight, were slowly received even by the most acute botanists, but have finally been almost universally adopted. The so-called naked seeds of Linnæus having been demonstrated to be one-seeded fruits, it appears that the Cycadeæ and Coniferæ alone have the peculiarity of producing truly naked seeds, and that they compose therefore a distinct natural group, to which the name of Gymnospermæ has very appropriately been given.

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* Trans. Linnæan Soc. of London, vol. vi, p. 312.

† Bot. Mag. tab. 2963.

‡ Travels in the Mysore, vol. ii, p. 469.

Aside from an examination of the ovula themselves, and their integuments, the botanist who studies the structure of the organs of reproduction in Cycadeæ, cannot but be convinced, that what were formerly called pistillate flowers are simply ovula in the first place, and afterwards naked seeds. The modified leaf, bearing the ovula upon its face or margin, is undoubtedly a carpellum in an imperfect state of development, the seeds of which would be enclosed in an ovarium, if the edges of that carpellary leaf were folded together in the usual manner. In *Cycas circinalis,* the ordinary appearance of the pinnated leaf is so far departed from as to exhibit in fact a flat scale-like carpel, with the rows of ovula upon either margin, thus closely resembling an ovarium formed of a single carpellum, (such as a follicle or legume,) spread open. In *C. revoluta* the leaf is in a less altered state, having at the extremity contracted pinnated divisions, (Pl. II, fig. 1,) but the part occupied by the ovula is, as in *C. circinalis*, the margin of the leaf. If, therefore, the *pistillum* be a modified leaf or carpellum, from the edges of which are produced the ovula, as is now admitted by the first structural botanists, the envelopes of the bodies which constitute the female organs in Cycadeæ and Coniferæ cannot be the calyx and ovarium, or indeed any thing else than the proper integuments of the seed; inasmuch as these bodies are produced upon the margins of the ovarium, the summit of which, if it were folded together, would become the style or stigma, and at the base, or surrounding which, would be found, perhaps, if in a state of sufficient development, the true floral envelopes. This argument receives additional force from the well known tendency of many leaves to produce upon their margins, either *buds*, (as in Bryophyllum and other plants,) which are in fact distinct individuals, or *ovula*, which are capable of becoming such by impregnation.

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* Vide Appendix to Capt. King's Voyage, p. 22.

The species of Cycas more commonly examined by European botanists, appears to have been *C. circinalis*, which, with regard to the seed itself, seems to be in a less perfect state of development than the species now before us. Richard's admirable figures represent only the former species; and Professor Lindley's essential characters of the order, in his "Introduction to the Natural System," are obviously drawn, so far as relates to Cycas, from *C. circinalis*.* In the specimen of *C. revoluta* before us, the most important difference arises from the presence of a brown membranous coating of the nucleus, perfectly distinct during the latter part of the growth of the ovulum, and contracting no adhesion with it. (Fig. 3, *a.*) This we believe to be the *tercine.* From the apex of this coat, if the ovulum be dissected carefully, (even in a nearly matured state,) a minute columnar summit (fig. 3, *b*) is seen projecting upwards from the nucleus to the perforated apex of the inner membrane (secundine) of the ovulum. This is undoubtedly the point through which impregnation takes place, and as we can perceive no trace of the fungous substance* which in Richard's figures is represented as occupying a considerable portion of space between the nucleus and the inner integument, (the ovarium,) may we not infer that in this species it, in a state of greater development, appears under the form of the *tercine* or proper coating of the nucleus?

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* In the "essential character" of Cycadeæ, given by Professor Lindley, in his "Introduction to the Natural System," the "pistilliferous flowers" are described as "either collected in cones, or surrounding the central bud, in the form of contracted leaves, *without pinnæ*, bearing the ovula upon their margins." Such is really the case in *C. circinalis*, where the leaf is contracted into a flat scale. But in *C. revoluta*, only that portion of the modified leaf upon which the ovula are produced, is without the usual pinnated divisions. The same distinguished botanist likewise states the "*gyrate vernation*" of the leaves to be an essential characteristic of the whole order; while, so far as we have observed, such is actually the case only in *C. circinalis*, which in the beautifully gyrate disposition of its young leaflets, and also in the whole appearance of the growing plant, exhibits in the strongest manner the affinity of this order to the Ferns. The vernation is by no means gyrate in *C. revoluta*, nor in our American Zamia, or in such of the exotic species of that genus as we have had an opportunity to examine.

In the mature seeds of *C. revoluta*, the micropyle is distinctly visible upon the projecting point of the corneous inner integument of the seed. This projecting apex assumes, in the *young ovula*, somewhat the appearance of a dilated stigma, and the *primine*, or outer membrane surrounding it, also shows an opening, (the *exostome*, fig. 2, *a*,) which is the perforated style of the older authors. In the present specimen of *C. revoluta*, the exostome has disappeared entirely, as the seeds increased in size, and the true foramen of the ovulum has closed in such a manner as only to show the micropyle upon the apex of the inner integument, showing however a distinct trace of the foramen leading down to the minute process arising from the nucleus. (Fig. 3, *c.*)

As the seed approaches maturity, the outer integument, which is still covered, like the contracted leaf with which it is connected, by a dense woolly pubescence, becomes in its *inferior part* easily separable from the inner integument, which has now acquired a hard and corneous texture; this in *C. revoluta* is undoubtedly distinct from the outer soft covering, both together constituting the two genuine integuments of the seed. That these two integuments are not easily separable throughout, is no proof of their not being distinct.

It is evident, therefore, that the so-called female flowers and fruit in Cycadeæ and Coniferæ, are naked ovula and seeds, not only from their position upon an imperfectly formed ovarium, (the convolution of which not having taken place, the seeds are consequently left naked upon its face or margin,) but from their similarity to other plants in the structure of the seeds themselves, having the same integuments, the same foramina in the ovula and micropyle in the mature seed, with only such slight deviations in structure as might be expected from the peculiar economy of these orders.

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* Sir W. J. Hooker, (Bot. Mag. tab. 2827.) has remarked the absence of this fungous substance in the specimens of *C. circinalis* which he examined, and also the presence of the same "membranous lining" observed by us in *C. revoluta.*

In a paper read before the "British Association for the Advancement of Science," at the fourth meeting, held at Edinburgh in 1834, Mr. Brown has adduced a new point of analogy between Coniferæ and Cycadeæ, in the tendency which exists in both these orders to the production of a "*plurality of embryos*" in the same nucleus. Occasional examples of this plurality were not unknown in other plants, but it was only in Cycadeæ that any constancy in this particular had been observed. Mr. Brown's recent investigations, however, have demonstrated not only the general occurrence of this plurality of embryos in many Pines, but also that a *regular arrangement* of these embryos within the nucleus takes place with much uniformity in both these families.*

A resemblance in inflorescence, fructification, and seed, are not the only points of agreement between Cycadeæ and Coniferæ. The simple cylindrical stem of the former, which resembles outwardly the trunk of the Palms, (a monocotyledonous order,) has been shown by M. Brongniart to be decidedly exogenous in structure—probably only growing in the form of a simple trunk, in consequence of the non-development of the axillary buds. The leaves of both the Cycas and the Fir tribes, as Prof. Lindley remarks, have the same parallel arrangement of veins, and both tribes exhibit a marked similarity in the fewness of their spiral vessels. Cycadeæ and Coniferæ still farther agree in a character lately discovered, as unique as it is important, and which alone would establish the fact of a strong affinity existing between the two orders; namely, the singular perforations in, or rather globules adherent to, the fibres of their wood, to which there exists nothing analogous in the structure of any other tribe of plants.†

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* Since writing this paper, a work has reached us, containing details of some remarkable experiments and investigations, made by Corda, on the impregnation of plants, conducted with that accuracy and minuteness so eminently characteristic of the Germans, which tends to elucidate this hitherto obscure portion of structural botany. Corda's experiments were made upon plants of the order Coniferæ, and the results are highly curious. Dr. Gray has lately read before the Lyceum of Natural History of New York a translation of Corda's memoir, which will probably soon be published. (See Vol. XXXI, p. 317.—Ed.)

† So permanent is this characteristic, that geologists have recently through it identified Coniferous wood, which has been imbedded in the coal strata for thou-

Placed thus as it were at the lowest step in the gradation of plants which have a vascular system and an exogenous structure, *Gymnospermæ* approach closely in their affinities to Flowerless Plants, through the Cycadeæ, which have mostly the same gyrate vernation as the Ferns, a manner of producing their seeds upon the margins of the leaves, analogous to the production of the thecæ in Osmundaceæ, and the same pinnated foliage and simple columnar trunks as some of the arborescent Ferns. They are also related to Equisetaceæ by a similar simplicity of structure in the female organs, if the sporules of that singular order are really naked ovula, as is very plausibly suggested by M. Ad. Brongniart. At least the resemblance of those organs to the female flower of Zamia, is in the highest degree obvious and striking.

But the relation between the Ferns and other flowerless plants, and Cycadeæ and Coniferæ, as well as the importance of these orders in former times, can only be properly appreciated by those who have paid attention to fossil botany, and are acquainted, by means of that interesting science, with the primitive flora of the globe. In those remote ages, when Ferns and marine Algæ, Equisetaceæ, and Lycopodiaceæ, with Cycadeæ, Coniferæ, and a few Palms, constituted the whole of the vegetable kingdom, these orders occupied a much more conspicuous station than at the present day. At that period, when, as geology has now incontestibly proved, the globe was tenanted by a "*race of reptiles*"—(those strangely formed animals, the aquatic and amphibious *Saurians*, which existed before the formation of the secondary strata,)—the vegetation of the earth was also in a corresponding primitive state of organization. Cellulares or flowerless plants, covered the greater portion of the globe; among which were Equisetaceæ of enormous size, herbaceous and arborescent Ferns, the latter of extraordinary altitude, and Lycopodiaceæ, an order now dwindled down to a few diminutive, moss-like plants, but which, it is thought by Brongniart, reached at that time the stature of our tallest forest trees. Associated with these, are found the first Coniferæ and Cycadeæ, which compose a very considerable proportion of the flora of those remote ages, being probably the next advance in the ascending scale of vegetable structure.

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sands of years! Messrs. Nicol and Witham, by grinding down to very thin plates sections of fossil woods, have been able to call in the microscope to their aid, and have ascertained their structure in the most satisfactory manner. Their examinations have led them to the conclusion, that all known exogenous fossil woods belong either to Coniferæ or Cycadeæ.

In the Ferns and other flowerless plants, we find the reproductive organs either obscure or imperfect; and in the next succeeding step, (the Coniferæ and Cycadeæ,) those organs, though distinctly characterized, are still formed in the most simple manner and accompanied with a corresponding simplicity in the structure of the wood, the leaves, and the whole vegetable system. As also we perceive the remains of the carnivorous and lacustrine *mammalia* succeeding in a later formation to those of the more primitive animals, so we find the Palms, some of the Liliaceæ, and many dicotyledonous plants, gradually assuming their respective places, just as the improving condition of the globe became more fitted to their respective organizations. In this way the *history of the earth* is unfolded to us; and such are the proofs perpetuated and unchanged through centuries of time, which show that it is through successive ages, and by a slow and gradual series of changes that the globe has acquired its present more perfect state; and that both departments of organized matter have advanced with equal steps and mutually dependent relations to that condition (perhaps still progressive,) in which they are found at the present moment.

EXPLANATION OF THE PLATES.

Pl. I, *Cycas revoluta*, with the crown of contracted leaves in the centre bearing the nearly mature seeds.

Pl. II, Fig. 1, the contracted leaf or imperfect ovarium, with the full grown ovules upon the margin of its lower half. Fig. 2, the young ovulum or female flower: *a*, *exostome*, or opening in the outer membrane, (primine.) *b*, the dilated apex of the *secundine* or inner membrane, through which the foramen leads to the nucleus. Fig. 3, the full grown seed: *e*, outer integument of a soft texture: *d*, inner integument, hard and bony. *a*, tercine, or third coat enveloping the nucleus (*f*): *b*, minute columnar process connecting the nucleus with the foramen *c*.

Fig. 4, impregnated nucleus. *a*, embryo. *b*, albumen. All of the size of nature.

Note.—It is proper to observe, that in the specimen of *C. revoluta* here figured, the ovula (there being no male flowers in bloom at the same time,) have not been impregnated. This perhaps renders it still more interesting; for while the ovula have gone on gradually acquiring color and consistency, as is the case when impregnated, there has of course been no embryo produced in the nucleus, which has the usual homogeneous appearance, with a trifling cavity in many of the matured specimens, where the embryo should have been found. It presents therefore a strong point of interest, in the fact that the coats of the seeds being here quite perfect and distinguishable, are of course proved, contrary to the opinion of some carpologists, *not* to be the *product* of fecundation. In Pl. II, Fig. 4, the embryo *a* is shown as figured by Richard and others.

The drawings in both plates were executed from a noble specimen in the exotic collection of J. W. Knevels, Esq., Newburgh, N. Y., which also contains several other fine specimens of Cycadeæ. This plant, probably about thirty years old, has flowered this season for the second time. The trunk is about four feet in height, the crown of foliage about eight feet in diameter, and the tuft of contracted leaves in the center eighteen inches in diameter.

Art. V.—*On the Economical Uses of some species of Testacea.*

The study of natural history in this country is evidently progressing; cabinets are formed, and a lively interest is taken in the subject, where not long since it was entirely neglected; and the day is nearly past when specimens are collected merely for their beauty, and preserved solely as ornaments. A scientific interest is now more or less attached to all such objects, and we believe that an earnest desire to study nature as she exists in the woods, in the air, and in the waters, is daily gaining ground. It is when the science is thus applied, and only then, that natural history is fully useful or interesting; and the more it is so studied, the sooner we reach the truth, and the greater is the pleasure.

The causes of this progress are many and obvious; but we cannot help thinking that the beautiful plates and the enthusiastic writings of Wilson, Bonaparte, and Audubon, as well as the valuable public museums, in most of our large cities, have done much to promote and force it on.* They have, as it were, forcibly turned the attention of the public to the subject, and laid open to them the stores of happiness and pleasure contained in such pursuits; by intimately mixing in their amusements they have torn from the face of science the mask of mystery and difficulty with which it was (and perhaps, in some parts, still is) unfortunately shrouded; and by making it familiar, have caused it to be admired and cultivated. But notwithstanding this, natural science has not yet been sufficiently brought home to the every day feelings and occupations of men. It is still looked upon as a thing apart, not as a thing connected with our education, with our pleasures, or our luxuries; and the knowledge of it, instead of being an assistance in our business, is considered by too many as only an hindrance to it. Professional writers on the subject have perhaps rather nourished, than helped to dissipate this prejudice: absorbed in the technical and more scientific parts of the subject, they have neglected to show its connection with the arts, and they have either overlooked entirely, or kept in the back ground the application of this knowledge. Natural history is a true science—as are all its branches; and as such they are the parents and fosterers of the arts. What do not the miner and the landowner owe the geologist?—the agriculturist to the zoologist and botanist?—and every one to mineralogy? and yet how seldom is it that we view these pursuits in this light. Were this connection more frequently reflected on, and the useful results of science more generally brought to notice, we are convinced that many who now neglect it would study it, as conducing to their own progress, as well as to that of their country, in practical knowledge; and those who now idly despise it, would become its warm and active advocates.

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* It may be necessary to explain to foreigners, that these museums, besides being open daily to visitors, on payment of a small sum, are generally used as exhibition rooms for ventriloquists, jugglers, fat men, *et hoc genus omne.*

As far as regards the cultivation of our minds, the utility of the science cannot be denied. It is from the contemplation of the works of the Creator, that the highest and most glorious thoughts of his majesty and beneficence are drawn; it is from the observation of them that we form our ideas of beauty, of elegance, or of grace; and in them we find a never-ceasing source of admiration, amusement, and instruction. This study enlarges the mind, in a peculiar manner softens the heart, and above all, prompts to a continued dependence on Him who "provideth the raven with his food," and decks the lily with more beauty than even Solomon in all his glory was possessed of.

"No man," remarks the great Bacon, "need say that learning will expulse business, but rather it will keep and defend the possession of the mind against idleness and pleasure, which otherwise may at unawares enter in to the prejudice of both." The greatest and best in all ages have been celebrated for their knowledge of and love for natural history. To mention but a few—Solomon, we are told, wrote a work on the subject: "of trees, from the cedar tree that is in Lebanon, even unto the hyssop that springeth out of the wall.... of beasts and of fowl, and of creeping things, and of fishes;" Aristotle, the deepest and most able ethical philosopher that perhaps ever existed, has left us a large and most learned work on the same; to Sir Isaac Newton, the christian is not less indebted than the philosopher; and in still more modern times, Cuvier is scarcely more celebrated for his researches into, and classification of nature, than for his political acme, general learning, and piety. But perhaps in no branch of natural history has this connection been more neglected than in Conchology; the generality of our shells are comparatively so minute, and their uses so seldom obvious to us, that with a very few exceptions, writers have altogether forgotten to mention the purposes for which society in general is interested in them; and yet on examining into this subject, we are surprised to find how much we owe to shells, for our luxuries, our pleasures, and our tables; and not only are we, but the ancients were eminently their debtors. The object of this article is to trace and elucidate those uses, and to show, in connection with their natural history, in what manner shell-fish either of old were, or, in the present day are, turned to profit. Had the writer been acquainted with any work in which this had been done, he probably would not have attempted it now; but in seeking information on the subject, he was surprised to find how meagre and contradictory were the statements in most of the Encyclopœdias, and works of general reference. In the ancient prose writers and poets, in books of history and commerce, in travels and scientific journals, he has found much information, but scattered far and wide, and not likely to be sought after by those who are but little interested in the subject, or unacquainted with the science. This he has endeavored to compress, as far as was possible with a regard to clearness, and by carefully giving the references, he has put it into the power of all to look to the original sources if they desire further information.

Of all the departments of natural history, Conchology appears to be here the most popular: owing to the maritime connections of this country with all parts of the world, but especially with India and the South Seas, opportunities of procuring specimens are enjoyed, scarcely surpassed elsewhere. And although our marine shells are neither numerous nor generally beautiful, yet those of our rivers are peculiarly interesting, and they are those to which we have most general access. Besides, a collection of shells has advantages over that of any other department; they are always beautiful, they take up but little space, and require no art to preserve them, while by the Linnean arrangement, a knowledge sufficient for amusement is easily acquired. But notwithstanding they are in general such favorites, little attention seems to have been paid to their economical uses, and still less, if any, to the improving or becoming possessed of the advantages foreign countries enjoy from them. While our fields and farm yards are stocked with plants and animals from every part of the world, we have not one shell which has been intentionally introduced for use. In England we are only aware of one attempt to naturalize marine shells, and how that has succeeded we know not; but were proper means used, there is little doubt that many of them would be successful. There, as here, they have animals, and birds, and plants from every part of the world—from the most contrary climates, and yet all thriving. The quail and the turkey from this country, the guinea-fowl from the burning plains of Africa, the peacock from Asia, and still more lately the kangaroo and emeu from New South Wales ;* and what is to prevent shells living and breeding in an element by far less subject to change in temperature than the air. The *Ostreæ* and *Pectines* in particular might, we feel sure, be successfully transplanted, if proper care were taken.†

To guess at the causes why this has not been done, were futile; but we may suggest, that it is perhaps owing to the very general ignorance on the subject, the employment of fishermen being inferior and ill paid, and the variations of the ocean throwing difficulties in the way greater than in the introduction of animals and birds on land. The descriptions of the shells have not been arranged systematically: but they stand according to their general interest, or their artificial connection one with another. It has also been thought best to omit all scientific descriptions, as most of the species are well known, and are to be met with in all books on Conchology.

The Linnean nomenclature has, with a few exceptions, been followed.

I. MYTILUS MARGARITIFERUS, (Linn.)—*The Pearl Oyster.*

Of all the Testacea, this species is the most valuable, the best known, and enters the most largely into the arts. It not only produces a beautiful and expensive luxury, but the shell is used in the manufacture of various useful and ornamental articles, while the animal serves as food for the inhabitants of those countries where it is most generally found; and although pearls are produced by many other bivalves, yet from their inferiority in color and size, this is the only species which can now be said to be of any real importance for this purpose. Anciently European pearls were extensively used, though never considered equal to the oriental; but as the trade between foreign countries has increased, so has the value of the former gradually diminished, and they are now seldom sought for, and of little comparative worth.

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* The following are the foreign animals domesticated in England. The original habitats (with the exception of the two last) are given on the authority of Jenyns, in his Manual of British vertebrate-animals. From Europe, *Cervus Dama*, *Perdix rubra*, *Cygnus Olor*, *Cyprinus Carpio*, *Esox Lucius* (?) From Asia, *Mus decumanus*, *Equus Caballus*, *E. Asinus*, *Phasianus Colchis*. From Africa, *Mustela Furo*, *Felis maniculata*, *Numida Meleagris*, *Anas Ægypticus*, *Cygnus Guineensis*. From North America, *Meleagris Gallapavo*, *Perdix Virginiana*, *Cygnus Canadensis*. From South America, *Cavia Cobaya*. From India, *Pavo cristatus*, *Gallus domesticus*, *G. lanatus*, *&c.* From China, *Phasianus torquatus*, *Cyprinus auratus*. From Australia, *Halmaturus giganteus*, (Ill.) *Rhea Novæ-Hollandiæ*.

† In Loudon's Magazine of Natural History, Vol. IX. pp. 572—574, mention is made of two shells which have naturalized themselves in Great Britain. The one is the *Mytilus polymorphus*, (Pallas,) supposed to have been introduced into the Thames on timber, and now spread through England and Scotland. The other is the *Mytilus crenatus*, (Linn.) which must have been brought from Bombay on the bottom of a ship, and has now firmly established itself, in company with the *M. edulis*, in Portsmouth harbor.

Ancient history.—During the earliest periods of which we have authentic history, the oriental pearl appears to have been known and appreciated; Job, who is supposed to have lived about B. C. 1520, speaks of it as being in his time of high value, and much esteemed.* Solomon frequently refers to them;† and Jeremiah,‡ speaking of the Nazarites of Jerusalem, makes use of a beautiful simile in describing them as more ruddy than pearls. In the New Testament, we frequently meet with them, as inferring great riches and splendor.||

In Rome pearls were extensively used, and of great value. Pliny tells us that in his time the ladies were not content with using them as ear drops and rings, but had them embroidered on their dresses and their sandals; they were not satisfied with solely wearing them, but must walk on them, and among them. They were obtained from the Red Sea, or brought to Rome by the Arabian merchants, from the Indian Ocean. They were the most numerous on the coast of Taprobane, (now Ceylon,) and Toïdis, and round the promontory and city of Perimula; but those from the western

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* Job, xxviii. 18. Dr. Hales supposes that Job lived at a much earlier period, and dates his trial, of which we have the account, B. C. 2130. He also appears to have lived in the land of Idumea, and if so, may very naturally have been acquainted with the pearls of the Persian Gulf.

† Proverbs, iii. 15, viii. 11, xx. 15, xxxi. 10.

‡ Lamentations, iv. 7. The Hebrew word is *Penemin*, and occurs only in the above cited passages. The Septuagint and the Vulgate translate it as "things hid, precious stones, or ivory." Our English version, with the one exception in Job, always renders it "ruby." David, in his Psalms, makes no mention of it, and as we do not hear of it till the time of Solomon, when riches from all parts of the world were collected at Jerusalem, we may infer that previously, the Israelites were not acquainted with it.—See *Calmet's Dic. of Holy Bible*, Art. Pearl.

|| Matthew, xiii. 45. Revelations, xxi. 21, &c. &c.

shores of Arabia, the Persian Gulf,* and the Red Sea were the most perfect and the most celebrated. The mode of capturing them seems to have varied little from that practised at the present day. Divers were employed, who brought them to the surface in nets, and they were packed in jars with salt till the animal was decayed. On being taken out, the pearls were found at the bottom of the jars.† Among the ancient philosophers, effects were continually attributed to causes the most inconsistent and the most contrary to nature—in fact, merely wild or fanciful guesses. Many were of course made as to the origin of these substances. The general opinion appears to have been, that they were formed by drops of dew falling into the shell, for which purpose it periodically rose to the surface; and Pliny gravely informs us that if the atmosphere was thick at the time, they were dark and clouded; if it was clear, they were white and brilliant. It is singular that the same opinion is found to prevail at the present day among the natives of Ceylon, and very similar to it, is the account of their formation recorded in one of the Sanscrit books of the Brahmins.‡ The same fancy also exists in the interior of Hindoostan.||

The nacre was manufactured into boxes for the preservation of sweet perfumes and precious ointments.

Of the pearls of ancient times, those belonging to Cleopatra are certainly the most celebrated, and though there is reason for believing that the account of her dissolving one of them in vinegar and drinking it to Antony's health at supper is an historical fiction, yet that a pearl or pearls of great value were in her possession is pretty certain. In Pliny's time, the two halves of a magnificent pearl, said to have been the fellow to the one destroyed, were hung in the ears of the statue of Venus Genetrix in the Pantheon. This author estimates the value of it at a sum equal to $375,000. Other persons are also reported to have dissolved pearls and treated their guests to the same expensive draught. Julius Cæsar gave £48,437 for one, which he presented to one of his mistresses.§

There was so much difficulty in obtaining pearls of exactly the same size and color, that the Roman ladies, about the time of the

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* As early as B. C. 311, the Persian Gulf was famous for them.—Macpherson's Annals of Commerce, I. 83.

† Plin. Hist. Nat. lib. ix. cap. 35. ‡ Asiatic Researches, V. 410, Lond. ed.

|| Forbes' Oriental Memoirs, II. 235.

§ Macpherson's Annals of Commerce, I. 144.

Jugurthan war, gave them the name of *Uniones*, which appears to have been the first occasion on which this word, now so well known, was applied to shells.*

The derivation of the Greek word μαργαρον or μαργαριτης, from which the other countries of the south of Europe have derived theirs, is supposed to be from the Tartar *margion*, signifying a globe of fire, and the Persian *marvarid*, meaning offspring of light.† In the present day, the Arabians, Persians and Turks use the word *merovorid*, for this gem.‡

In Rome they were entailed and handed down to posterity, and if sold, a warrantry of their identity required.

Modern history.—The pearls and shells used at the present day are chiefly brought from the island of Ceylon, where the fisheries are extensively prosecuted, but other parts of the eastern as well as the western hemisphere are celebrated for producing them. In India the chief places are the island of Bahren or Beharein in the Persian Gulf,§ Catesa on the coast of Arabia Felix, and near the city of Nipehoa, on the lake of the same name in Chinese Tartary, as well as in the Red Sea, and on the coast of Japan. A few also are procured near Java and Sumatra. Pearls are brought in great numbers from the Persian Gulf to Bombay,‖ but those sold at Madras, and which are found in the Gulf of Manaar, are more highly esteemed in Europe than those procured in this place.¶

The best shells of commerce are from the Sooloo Islands, situated between Borneo and the Philippines, the shores of which afford the finest and largest shells hitherto discovered. There is also a fishery at Tuticoveen, on the coast of Coromandel, which is held as a monopoly by the British East India Company. They are also found off Algiers, in the Mediterranean; in 1826, this fishery was farmed by an English company, but with what success is not known.** They also inhabit the islands of the South Seas, especially on the coasts of the Paumotu Islands, to which places vessels are sent from New South Wales, and prosecute the fisheries to some extent.*

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* Plin. Hist. Nat. ix. 35.

† Rees' Cyclopœdia, Art. PEARL.

‡ Calmet's Dictionary of the Holy Bible, Art. PEARL.

§ "We can hardly consider any of the fisheries on the Persian Gulf as belong-"ing to Persia, for although the monarchs of this nation have always claimed the "sovereignty of the sea, they have at no period had a navy that could enable "them to contend with the Arabic rulers of the opposite coast."—Sir J. Malcolm's History of Persia, II. 515.

‖ Heber's Narrative, II. 165. *Am. Ed.*

¶ Kelly's Univ. Cambist. I. 95, note.

** McCulloch's Commercial Dictionary, Art. PEARL.

In the Atlantic Ocean, they are chiefly fished for on the coast of Terra Firma, in the Gulf of Mexico, near the island of Cubagna, and on the Margarita or Pearl Islands. The River de la Hache abounds with them.†

In the Pacific, they are plentiful on the island of Gorgona, and generally along the coast of the Bay of Panama, and being found in shallow water are easily obtained.‡ In the ocean around California, and in the adjacent islands, they are also found in great abundance.§ The oriental pearls are however by far the finest, surpassing the occidental specimens in color, clearness and size.

In the time of Marco Pólo, (1295,) Bagdat, on the Tigris, was the great mart of the world for pearls, and all Europe was supplied from thence.||

In 1506, the Spaniards carried on a large pearl fishery in the West Indies. About the same time adventurers flocked to California from all parts, to enrich themselves with these jewels, and in the beginning of the 18th century, numbers from all the western ports of Spanish America, congregated there for the same purpose.

Natural history.—The shell of the young of this species is comparatively smooth, but as they grow older it becomes more scaly, rough and unequal. When full grown, it is sometimes ten or twelve inches long, and the length rather exceeds the breadth. These are thick and ponderous, but the young shells are brittle and slightly eared.¶ It is in the former that pearls are chiefly found, the young ones being either entirely without them, or having them very small and inferior; and the practised fisherman can generally judge in which he will find the largest and most valuable.** They lie in banks or beds, generally near coasts, and in water from three to fifteen fathoms, and like the other members of the genus, adhere to the rocks and to each other, by the Byssus. The older shells lie separately, while the young are attached to the surface of their par-

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* Ellis' Polynesian Researches, Vol. II, pp. 133, 207.

† Chalmers' Universal Dictionary, Art. Pearl.

‡ Burney's Chron. Hist. of Discoveries, IV. 168.

§ Natural and Civil History of California, I. 49.

|| Macpherson's Annals of Commerce, I. 456.

¶ Dillwyn's Descr. Catal. of Shells, I. 302.

** Asiatic Researches, V. 393—411.

ents. The Byssus is of a dark green color and metallic hue, and they can move slightly by contracting or extending the muscle to which it is attached. The ancients supposed them to be endowed with peculiar powers of locomotion, describing them as grazing at the bottom of the ocean, with a leader to direct them, &c.* but whether they have any such power is extremely doubtful, at least after attaining the thick shell.† The sexual differences have not hitherto been discovered, although the natives of Ceylon pretend to distinguish the sexes, by the appearance of the shell. Those that are large and flat, they call males; those that are thick, concave and vaulted, they call females; but Mr. Le Beck, who appears to have carefully examined and dissected this animal, declares he was unable to discover any difference.‡

Like the *Ostrea edulis*, this fish appears to thrive best in a mixture of fresh and salt water. Pearls are always the most beautiful in those places of the sea where a quantity of fresh water falls, as at the mouth of rivers and streams,¶ while those produced by the shells growing on rocky bottoms, are found to be of a better water than those that lie among sand and coral.

Of the many suppositions as to the cause of pearls, that of Raumeur is the most probable, and in the present day generally adopted. He supposed them to be owing to a disease in the fish, as calculi in mammalia, and to arise from a ruptured or morbid state of the vessels provided for the secretion of the materials of the shell: most experiments and observations go to prove the truth of it.||

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* Pliny, ix. 35.

† Mr. Montgomery Martyn makes the following remarks on this shell, but from his very obvious ignorance of natural history, and the general inaccuracy and haste of his observations in this department, they are very little to be relied on. We however give them, as from a modern and widely circulated work, and not entirely without its merits, although abounding in faults. "At certain seasons, the young oysters are seen floating in masses, and are carried by the currents round the coasts (of Ceylon.) They afterwards settle and attach themselves by a fibre or beard on coral rocks, and on sand; they adhere together in clusters; when full grown, they again separate, and become locomotive. The pearls enlarge during six years, and the oyster is supposed to die after seven years."—Martyn's History of the British Colonies, 2d ed. I. 522, note.

‡ Asiatic Researches, *ut supra*. Dr. Kirtland remarks the same with respect to those species of the family of *Naïades* of Lamarck, which are found in the waters of this country, and he is "persuaded that each sex possesses a peculiar organization of body, associated with a corresponding form of the shell, sufficiently well marked to distinguish it from the other."—Silliman's American Journal, Vol. XXVI, pp. 118, 119.

¶ Bruce's Travels to discover the Sources of the Nile, VII. 322.

|| Transactions of the French Academy.

They are found in the body of the animal, and not confined to any particular part. Some contain but one, some a multitude of small specimens, known by the name of *seed pearls*, while in the shell itself, and protruding above the surface, are frequently circular nodules resembling them; as these must be cut, and on one side are flat, they can only be used for setting, and of course are of less value. They are technically termed by jewellers the *wens of pearls.*

There is a common opinion that the animal may be forced to produce the gems by artificial means. The inhabitants of the shores of the Red Sea were said to have wounded them, and returned them to the water; and the Chinese we are told insert beads of the nacre into the shell, to be covered by the animal with the perlaceous substance.* But these accounts from many obvious reasons are improbable, and we have not been able to meet in modern histories with any authenticated instance of its having been done. In river shells it might be more easily effected; and we shall have to refer to it again under the description of *Mya margaritifera.* They sometimes grow so large as to hinder the shell from shutting; in which case the fish dies,† and they are comparatively not uncommon of the size of a small bullet.

On analyzation, perlaceous shells appear to be formed of animal matter, applied stratum upon stratum, with carbonate of lime between them; each membrane has a corresponding coat or crust of carbonate of lime, secured by a new membrane; and each coat of lime is so situated that it is always between every two membranes, beginning with the epidermis, and ending with the last formed internal one. The animals which inhabit these stratified shells, increase their habitation by means of a stratum of carbonate of lime secured by a new membrane, and as every additional stratum exceeds in extent that which was previously formed, the shell becomes stronger in proportion as it is enlarged; and the growth and age of the animal may be denoted by the number of strata, which concur to form the shell. Pearls prove also to be similar in composition to the nacre, and they appear to be formed of concentric coats of membrane and carbonate of lime. The wavy appearance and iridescence of mother of pearl, and of the pearl itself, are evidently the effect of the lamellated structure and semi-transparency. On dissolving the lime by acid, the animal frame-work of the shell is left exposed.*

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* See Rees' Cyclopœdia; Encyclopœdia Americana, &c. &c. Art. PEARL.

Beekman, in his History of Inventions, vol. ii. page 5, third Lond. Ed., seems to have been the first in more modern times to have given extended publicity to this opinion. He quotes as his authority a German work, and adds, that "the truth of this information cannot be doubted." That it *might* happen, we do not mean to deny, but sufficient authority is wanting to prove it, and many powerful reasons are against it. How and when does the reader suppose the pearls were inserted? on a string containing five beads; and the clever Chinese caught the shell when it rose to the surface in the spring to enjoy itself! Of course next year it had to be caught again to get at them, but how we are not informed. He has however been servilely copied by most subsequent writers on this subject, with the exception that he expressly says the shells are fluviatile, while his copyists confuse them with, or describe them as the present marine species. Beekman confesses that some experiments of the kind, made in Bohemia, were without success. Postlethwaite gives an account in some respects similar, but still less creditable, from a Chinese work. The pearl was made of several materials; among others, nacre and bruised pearls, and the shell was kept in a basin, to be daily fed on medicinal and gummy roots. He himself allows that it does not appear probable. (See Postlethwaite's Dictionary, vol. ii. Art. *Pearl.*) It is time however that such fables were exploded, and left out of works professedly scientific, and bearing on the title page the name of some learned editor, assisted, as we are told, by "eminent professional gentlemen."

† Chalmers' Universal Dictionary, Art. PEARL.

Fisheries.—In the older writers, the following mode of catching this fish is given, and though it differs in some respects from the latest accounts, yet the difference may probably be owing to the lapse of time, or from being practiced at different places. It however refers to the island of Ceylon, though we are not told the exact part.

There were two seasons when the shells were particularly sought after, during March and April, August and September. The vessels used were of two sizes, the larger carrying two divers, the smaller only one. In the morning they set sail for the banks, with the land breeze, which at these seasons blows regularly, and on arriving there anchored. The diver bound a stone to his body about six inches thick and one foot long to enable him to walk against the water, and another of from twenty to thirty pounds weight to his foot in order to sink him; around his neck was a net to hold what he collected, and he was provided with strong gloves or a short iron rake, to tear the shells from the rocks.† His ears and nostrils were filled with cotton, and a sponge dipped in oil was fastened to his arm that he might occasionally breathe without inhaling water.‡ Round his waist was a cord to pull him up again when he grew tired. Thus equipped, he leaped overboard, and collected as many shells as he could while he remained under water. We are told they sometimes remained below fifteen to twenty minutes, but this seems a very gross exaggeration, from two to seven minutes being the general period in the present day; they repeated this while they stayed as often as they could. In the evening the boats returned with the sea breeze, which then blows on land. On the beach the fishers dug pits four or five feet square, and throwing in the oysters, raised heaps of sand over them to the height of a man, so that at a distance they looked like an army ranged in order of battle. When the animal was decayed, these were opened, and the sand passed through sieves, to collect the shells. These again were passed through nine sieves, to assort the qualities, and the smallest sold as seed pearls.

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* Philosophical Transactions of the Royal Society of London, xviii. 554. Abrid. Ed. 1807.

† Chalmers' Dictionary, Art. PEARL.

‡ Encyclopœdia Americana, Art. PEARL. "According to the depth of the water, the seal takes into its stomach a quantity of pebbles, as ballast, as it were, being obliged to sink itself. To enable it to dive so admirably, it collects a quan-

The manner of catching them in the West Indies differs very little from this mode. The employment is considered very unhealthy, and the divers are continually in danger from sharks. Among the Colchi, during the first century of the Christian era, so dangerous was this business considered, that condemned criminals were entirely and solely employed in it.*

Since the British have held possession of the island of Ceylon, the pearl fishery has been a monopoly in the hands of government. It is now a more important business, and carried on with greater skill and tact. About twelve miles from Manaar, and in the gulf so called, lies the bay of Condotchy, on which is a small town of the same name. Off here the fishing banks lie, and extend several miles along the coast from Manaar Sound to Arippo. The principal one is about twenty miles out to sea. At this town, scarcely inhabited except during the fishing time, all the boats collect in the beginning of the season; few of them belong to the island, and most of them are brought annually from the coast of Coromandel and Malabar. The fishing is confined to one season, and begins generally about the second week in February. The first thing that is then done is to sell by auction to the highest bidder the right of fishing for the season; and he either catches all himself, hiring the boats, or lets out the privilege to others. The fishing seldom continues above thirty entire days, for

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tity of blood on the right side, *the same as is found to be the case with those persons employed in diving for pearls.*"—Dr. Riley, at the meeting of the British Association at Bristol, 1836, reported in the Literary Gazette, September 3d.

* McPherson, I. 172.

though it may be carried on till the 15th of April, yet owing to holydays, storms, and other causes, they seldom work more than this time in the two months. It is found necessary to leave the banks from four to seven years to recruit, so that parts only are annually disturbed. Each boat carries twenty one men, ten of whom are divers, and one the *Sandel* or head boatman. At ten o'clock at night, on a signal, the boats leave Condotchy together, with the land breeze, and reach the banks about day light. They immediately begin diving, and continue till the sea breeze sets in. The divers are very expert, and go down by fives, so that there is always one half resting. They require no assistance, except a stone to their feet, a net and a rope. From their earliest infancy they are accustomed to the exercise, and fearlessly descend to the bottom at a depth of from five to ten fathoms, in search of the treasure. The time they generally stay below is about two minutes, but some have been known to exceed seven. To continue longer than this is supposed to be impossible. On coming up they generally discharge water from the nose and mouth, and occasionally blood. The cargo of one boat may amount to thirty thousand oysters, if the divers have been industrious and successful.

On landing them, some merely throw them on mats to rot in the open air; others bury them in enclosed pits about two feet deep, till the animal has dried up. For sorting them they make use of brass plates, perforated with holes of different sizes. The piercing is accomplished by an instrument peculiar to the natives, and which they use with much ingenuity. It is a conical piece of soft wood, on legs, with pits for the larger pearls. The smaller ones are beaten in with a wooden mallet. The drilling instruments are iron spindles of various sizes, and are turned round in a wooden head by means of a bow, while the pearl is occasionally moistened with a little water.*

In the Persian Gulf there are two seasons, but shells are fished for chiefly in July, August and September. The divers use a piece of horn to compress their nostrils, and bees' wax to stop their ears.†

In California, the banks (which are there called *Hostias*,) lie in three or four fathoms of water, and the fishery is carried on by divers, but owing to the little depth at which they are found, with neither labor nor difficulty.‡ The fishery at Colombo, in Ceylon, was at one time very productive, but some years ago it entirely failed; and though it has been lately (1825) resumed, the success has been small.[*] These sudden failures occasionally occur in most banks,[†] but we have not met with any satisfactory explanation of the cause. In the Red Sea this species holds the first rank among pearls, and is called the *Lulu el Berber*—i. e. the pearl of Berber, or Beja, the country of the shepherds.[‡]

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* Asiatic Researches, *ut supra*.

† McCulloch, Art. Pearl.

‡ History of California, I. 49.

Uses.—Besides the pearls, the shell and fish are both used. The former in the manufacture of knives—for inlaying, in the constructing of ornaments, &c.; and the latter as food. The nacre is generally separated from the external part by the lapidary's mill or aqua fortis, and cut up by instruments made expressly for the purpose.[§] The inlaying of mother of pearl has been brought to high perfection at Jerusalem; great quantities of the shell are carried daily from the Red Sea to that place, and of these, all the fine works—the crucifixes, the wafer boxes, and the beads are made, which are sent to the catholic countries of South America.[¶] We may suppose the Romans were ignorant of this art, as Pliny makes no mention of it. The fish is eaten by the lower classes of the Singhalese, either fresh in their curries, or cured by drying. In this latter state they are carried to the coast of Hindoostan and disposed of there.[||] In the Island of Gorgona also, they are used by the Indians and Spaniards, and hung on strings to dry. If eaten raw they taste coppery; but when boiled are considered good.[**] The aborigines of California were ignorant of the use of the pearl, but they used the fish, throwing it on the fire to get at it and cook it.[††] It is said also, that on the discovery of Mexico, the Spaniards found these gems in use and esteemed by the Indians, but that from the same manner of killing the animal their color and lustre were destroyed. In the Society Islands, the Indians manufacture their fish-hooks out of this shell, the glitter of which serves instead of bait.[‡‡]

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[*] Heber, II. 165.

[†] Dictionnaire Universelle de la Geographie, par J. Peuchet, Art. CEYLON.

[‡] Bruce, VII. 323.

[§] Ency. Ameri. Art. NACRE.

[¶] Bruce, VII. 322.

[||] Asiatic Researches, *ut supra.*

[**] Burney, IV. 168.

[††] Hist. California, I. 49.

[‡‡] Ellis' Polynesian Researches, I. 146.

Besides being used as an ornament, pearls were formerly in high estimation as a medicine, and given in cordial potions; but as they differ in no respect from any other calcareous earth, they have been long neglected, and are now, we believe, never administered.* The ladies, however, still use a cosmetic under the name of pearl powder, but which is, notwithstanding, understood to be metallic.

The most remarkable pearls of modern times are, one which was in the possession of Philip II, in 1574, as large as a pigeon's egg; one mentioned by Tavernier in the hands of the Emperor of Persia in 1633, and which was purchased of an Arab for the extraordinary sum of £110,400; and that of the Emperor Rudolph, mentioned by Boetius, called *La Peregrina*, of the shape of a pear, weighing thirty carats.† In Europe, in common with all jewels, they are sold by the carat. In Asia, the weight differs in different states. At Bombay and Madras pearls are valued by two kinds of weights, real and nominal; by the former they are weighed, by the latter sold.‡ In the former country, pearls of a "white water" are most sought after, but the Indians and Arabs prefer those of a "yellow water."‖

Artificial pearls, of which the Romans appear to have been ignorant, are made of thin glass beads lined with the scales of, or a white powder from the belly of the Bleak, (*Cyprinus Alburnus*, Linn.) and filled with wax. To obtain a pound of scales, four thousand fish are necessary, and these do not produce four ounces of the *essence d'orient*, as the perlaceous substance is termed. At St. John de Maizel in the Challonnois is a manufactory in which ten thousand pearls are made daily.¶ From the facility and accuracy with which these are manufactured, the price of the real article in modern times has much declined. A handsome necklace of Ceylon pearls smaller than a pea, costs from seven hundred and fifty to thirteen hundred and fifty dollars; but one of pearls about the size of peppercorns may be had for about sixty five dollars; the pearls in the former selling at five dollars each; those of the latter at thirty seven cents.

The importation of mother of pearl shells in England in 1832, amounted to seven hundred twenty one thousand five hundred and twenty seven pounds weight.**

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* Hooper's Med. Dic. Art. MARGARITA. † Chalmers, Art. PEARL.

‡ Kelly's Univ. Cambist. Vol. I. pp. 92, 95.

‖ Rees' Cyclopœdia, Art. PEARL.

¶ Beekman, II. 16. ** McCulloch, Art. PEARL.

II. Mya margaritifera, (Linn.)—*The Horse Muscle.*

Next to the last species, this shell is the most celebrated for its pearls, and which in old times not unfrequently came into competition with those from India. Julius Cæsar is said to have been stimulated to the invasion of Britain by the sight of the pearls brought from it;* and he certainly on his return to Rome presented a breastplate made of them to the Temple of Venus Genetrix.† They appear to have been at that time, A. D. 14, an object of commerce to Gaul, if not further south.‡ Forty years later they were common in Rome. Pliny informs us they were used in his time, and though of inferior worth, were often so large and beautiful as to be of considerable value. In general, however, they were small, dim, and wanting in lustre.

About the year 1120, the Scotch pearls were in great request. King Alexander I. is said to have exceeded all men in that species of riches, and his pearls, on account of their large size and superior brightness were celebrated and coveted in distant countries.§ In 1355, they were still an article of exportation. They were esteemed in France, but not equally with those of India, as appears by the MS. statutes of the Goldsmiths' Company at Paris, where it is ordained that no worker in gold or silver shall set any Scottish pearls among the oriental ones, except in large jewelry for churches,‖ for which, probably, a sufficient quantity of the oriental pearls could not be obtained, or were too expensive.

Among the articles exported to Antwerp from Scotland in 1560, and enumerated by *Guicciardin,* we find "fine large pearls" mentioned.¶ In 1665, they were still sought for and worn in England, and a writer in the Philosophical Transactions of London at that time, makes mention of one found in Ireland which weighed fifty six carats, and was valued at £40, and of another for which £80 had been refused, besides "a vast number of fair, merchantable pearls, too good for the apothecary," offered for sale by persons from the same place.** About 1760, the wearing of real pearls coming more into fashion, those of Scotland, which had previously been almost neglected, increased in price greatly beyond their value, and superior often to the price of oriental ones when bought in the east.[*] At present we are not aware that they are sought for, except as curiosities.

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* Sueton. Vit. Jul. Cæs. cap. lxiv.

† Plin. Hist. Nat. lib. ix. 35.

‡ Macpherson, I. 133.

§ Macpherson, I. 318.

‖ Ibid, I. 556.

¶ Macpherson, II. 131.

** Phil. Trans. of the Royal Society, II. 831.

Natural history.—This shell is common to most of the rivers of Europe, but is chiefly found in those which are violent and rapid, and in the temperate or colder climates. In Norway and Sweden they abound, and they are found plentiful in the streams of Western Siberia.[†] In Great Britain they are common in the English, Welsh, and Scotch, and some of the Irish rivers; in all which the fisheries were formerly prosecuted. The same opinion as to the formation of the pearls in these was held, as with respect to the last species; and the supposition, that they were formed of dew, or of eggs which had not been evacuated, was supported by scientific writers as late as the seventeenth century.

In 1761 Linnæus informed the King and council of Sweden that he had discovered an art by which muscles might be made to produce pearls, and he offered to disclose the method for the benefit of the kingdom. This however was not done, but he disposed of the secret for about five hundred ducats to a German. At the death of this man it was offered for sale, sealed up to the highest bidder, but what became of it is not known. Linnæus once showed Beekman a small box filled with pearls, and said, "*Hos uniones confeci artificio meo, sunt tantum quinque annorum, et tamen tam magni;*" and he declared that he could succeed in the same manner with all kinds of muscles.[‡] They lie in the mud, generally sticking up in a horizontal position by one end.

Fisheries.—Lying generally in shallow water, little exertion or skill is necessary in procuring them, and the business was probably never sufficiently extended or valuable to cause either their cultivation or particular protection. The manner practised in procuring them in the north of Ireland in 1660, is described in the Philosophical Transactions, and exhibits neither art, nor much intelligence. In the warm months before the harvest, while the rivers were low and clear, the poor people waded into the water, and some with their toes, some with wooden tongs, and others with a sharpened stick, thrust into the open shell, brought them to the surface; and although by common estimate, not above one shell in one hundred might have a pearl, and of these pearls, not above one in one hundred might be round and clear, yet sufficient were found to remunerate those who sought for them. "The natives, though very foul eaters, will not eat the fish." The shells which contain the best pearls are wrinkled, twisted and bunched, and not smooth and equal as those that have none; and "the fishermen will guess so well by the shell, that though watched never so closely, they will open such shells under water, and conceal the pearl in their mouths or otherwise." They do not appear to have been laid in heaps to rot as the muscle is, but opened and the gem extracted immediately.*

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[*] Macpherson, III. 419. Bruce, VII. 321.

[†] Cochrane's Pedestrian Tour.

[‡] Beekman, II. 5—11.

The following ingenious mode of catching them was practiced about fifty years since, in the river Teith, county of Perth, Scotland, and we may remark, that it is the only instance we can meet with, where any skill or invention is obvious in the manner of fishing for them. A kind of spear was made use of, which was shod at the point with iron spoons, having their mouths inverted. The handles were long, elastic, and joined at the extremity, which was formed into a socket to receive the shaft. With this machine in his hand by way of a staff, the fisher, being often up to his chin in water, groped with his feet for the muscles, which are fixed in the mud and sand by one end. He pressed down these iron spoons upon the point, so that by the spring in the handles they opened to receive the muscle, held it fast, and pulled it up to the surface of the water.† It was customary at one time for the Crown to grant patents for the privilege of fishing for pearls in particular streams. Sir John Hawkins held a patent of this sort, and in 1633, one which had been granted to Robert Buchan of Auchmacoy, in the county of Aberdeen, was repealed by Charles the First.‡ There were also some fisheries in Saxony, which were monopolized by the government, but whether productive or not, we are not informed. They are called by the Welsh, *Cregin Diluw*, or deluge shells, as if they had been left there by the flood.§

III. PINNA ROTUNDATA? (Linn.)

Before the introduction of the silk worm into Europe from the East, this shell was of much importance in the arts. The only silk of any value, or in any quantity, that could then be obtained, was procured from it, and it was only gradually that it gave way before the cheaper and more beautiful fabric. The animals inhabiting the Pinnæ have the power of fixing themselves to any substance, by throwing out an extensile member, and discharging from its tip a drop of gluten, which, by the retraction of the same organ, is formed into a silky filament, and by frequently repeating this operation a thick tuft is formed, by which the shell is fastened in any situation the animal chooses.[*] It is of these silky filaments, which are of a rich gold color, that cloth was made; and of such value was it, that for a long time none but monarchs and persons of high rank wore it, as their robes of state.

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* Phil. Trans. II. 831.

† Sinclair's Statistical History of Scotland, XI. 600. ‡ Ibid. IV. 423.

§ Pennant's British Zoology, *in loco.*

There have been endless disputes among commentators, what material was meant among the Greeks and Romans by the word *Byssus*, and they have not unfrequently confounded the *Byssinum*, the *Bombicina*, and the *Sericum* of the ancients altogether as one. Some have supposed the *Byssinum* to be a cotton, some make it the same with the *Sericum*, and others, very fine linen. The fact however seems to be, that the word was frequently applied indiscriminately to any texture finer than woolen; but on speaking appropriately, it was used solely for the stuff manufactured from the produce of the Pinna.[†] It was in use during the earliest periods, as we find David,[‡] B. C. 1043, clothed with a robe of it, and we can trace it as an article of commerce until near the end of the fourteenth century. The Hebrew word is *Butz*, but is in general erroneously translated, and in our version of the Bible is confounded with real linen and cotton, under the name of "fine linen." It does not appear in the text of Moses; and the only books in which it occurs are Chronicles, Ezekiel[§] and Esther.[‖] In Chronicles we see David with a mantle of *Butz*, with the singers and the Levites. Solomon used it in the veils of the temple and sanctuary.[¶] Ahasuerus' tents were upheld by cords of it; and Mordecai was clothed with a mantle of purple and *Butz*, when king Ahasuerus honored him with the first employment in his kingdom, about B. C. 509. It was among the merchandize imported into Tyre from Syria, enumerated by Ezekiel,

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[*] Dillwyn, III. 24.

[†] "῾Αι δε πινναι ᾽ορθαιφυονται ᾽εκ βύσσου ᾽εν τοις ᾽αμμωδεσι και βορβορωδεσιν;" and Duval in explanation adds, "*ex bysso, id est, villo, sive lana illa pinnali.*"—Aristotle, Oper. omnia. Paris, MDCXXIX; tom. II. p. 844.

[‡] 1 Chron. xv. 27.

[§] Ezek. xxvii. 16.

[‖] Esther, i. 6. vii. 15.

[¶] 2 Chron. iii. 14.

B. C. 588. Lastly, it is to be observed that there was a manufactory of this article in the city of Beersheba in Palestine.[*]

The *Butz* must have been different from common linen, since in the same place where it is said David wore a mantle of Byssus, we read likewise he wore a linen ephod. Herodotus (B. C. 450) says, that the bodies of rich persons in Egypt were wrapped in bandages of it, after being embalmed.[†] In the time of Pliny, the Roman ladies were particularly fond of it, and would buy it for its weight in gold.[‡] In the New Testament the word frequently occurs, where it is translated the same as in the Old, but always indicating riches and splendor.[§]

In later times, it was chiefly brought from India, Egypt, and Elis in Achaia, and some apparently from the coast of Judea. In 1265 it was imported from Asia into England,[||] and in 1380 we find five bales of it mentioned, in the catalogue of the cargo of a ship bound from Genoa to Bruges in Flanders, and which was driven ashore on the English coast.[¶]

It is still manufactured at Palermo into gloves and other small articles.[**] It is also used at Taranto, (the ancient Tarentum,) where it is called *lana pesce* or *lana penna*. Having been cleaned, combed, carded and spun, it is finally knit into stockings and gloves of a soft and extremely warm texture, and a beautifully glossy brown color, enriched with a golden hue. They are reckoned excellent preservatives against cold and damp, but the price renders the article more an object of luxury and curiosity than of general utility.[††] To spin this Byssus they leave it some days in a damp cellar, to moisten and grow soft; after this they comb it to get out its impurities, and lastly spin it as they do silk; and though grossly spun, it appears much finer and more beautiful than wool, and does not come much short of silk itself.[‡‡] A species of Pinna is much fished for in the Red Sea, as it contains pearls. The inside is of a beautiful red, and the pearls always partake of this color, while they are generally the darkest as they approach the large end, which is the most brilliant.[||||] Bruce supposes, that from this circumstance, the Hebrew word *Penin*, or, as it is more generally written in the plural,

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[*] See Calmet's Dict. Art. Byssus.

[†] Σινδόνος βυσσίνης. Herod. lib. ii. cap. 86. Compare also the Greek of Luke, xxiii. 53.

[‡] Plin. Hist. Nat. lib. xix. cap. 1.

[§] Luke, xvi. 19. Rev. xviii. 16, &c.

[||] Macpherson, I. 415.

[¶] Ibid. V. 590.

[**] Dillwyn, III. 24.

[††] Hon. Keppel Craven's Tour through the southern provinces of the kingdom of Naples, p. 185.

[‡‡] Rees' Cyclopœdia, Art. Byssus.

[||||] Bruce, *ut supra*.

Penemin, Pearl, is derived, as the root of it signifies *red*, and that it was from these shells the pearls used in Judea were taken; of course it is impossible to decide, as oriental pearls are also found thus tinged, but it is not improbable.*

The derivation of the word *Byssus*—βύσσος, is probably βυσσὸς, ***Ionicé*** for βυθὸς—depth, as being found in comparatively deep water. The word Pinna has been idly supposed to be derived from the Latin word *penna*, a feather—from an imagined resemblance between the shell and the quill. The Greeks, however, used the word *πινα* or *πιννα*, and must have derived it from the Hebrews. Bruce asserts, that in the Red Sea they live in the mud without any byssus, sticking up horizontally on the sharp end; he is, however, most probably mistaken. They were the only shell fish that he found there not eatable.

IV. MYTILUS ———? (Linn.)

There is another shell in the Red Sea, which is regularly sought after as containing pearls. It is a Mytilus, and appears nearly to resemble the ***M. edulis***. It is the rarest kind, and is chiefly found at the north end of the Gulf, and on the Egyptian side. The only place where Bruce ever saw them, was about Cossier and to the northward of it, where there was an ancient port, which took its name ***Myos Hormos***, the ***Harbor of Muscles***, from their locality. The fish contains often pearls of great beauty for lustre and shape, but seldom of a white or clear water. They lie in the deepest and stillest water and on the softest bottom, and they stick upright by their extremity.†

V. In Australasia we are told of another large pearl-bearing shell, but of what genus we are not able from the accounts to decide. It is the Menangey—occasionally denominated the New Holland cockle, and it produces large and beautiful pearls. Mr. Dalrymple mentions one belonging to Lord Pigot, which weighed 8 dwt. 17 grains, and was $\frac{49}{56}$ inch in length, and $\frac{38}{56}$ inch in diameter.‡

(*To be continued.*)

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* Statius (*Silviæ*, 4. 6. 18.) uses the phrase '*Erythræus lapillus*,' and some other writers make use of the words '*Erythrææ gemmæ*,' for pearls, but whether from their red hue, (ερυθραιος) or because they were from the Red Sea, ***Erythræum Mare***, is questionable. Pliny says that the pearls from this sea in his time were the most orient and clear. Plin. ix. 35.

† Bruce's Abyssinia, VII. 314, and VIII. Plate 43.

‡ Burney, Chron. Hist. of Dis. I. 94.

Art. VI.—*Notes on a Tour in France, Italy, and Elba, with a notice of its Mines of Iron;* by Prof. F. Hall—in a letter to the Editor, dated Porto Ferrajo, Elba, July 24, 1836.

TO PROFESSOR SILLIMAN.

Dear Sir,—Being wind-bound, in the capital of this romantic island, and without occupation, I have concluded to spend an hour this morning in telling you something of what I have seen on this side of the Atlantic. You are aware that I embarked at New York for Havre; eighteen days brought me there. From that port I travelled, in an elegant and commodious steamboat, up the serpentine Seine, through a country whose landscapes are enchanting, and not surpassed in richness and variety, by any in the United States, those of the Hudson, perhaps, excepted. The land, as you proceed up the stream, is first level, or slightly uneven, then more undulating—the waves growing larger and larger till you come into the neighborhood of Rouen, where I landed, and where the surface is hilly, and even mountainous. The geological structure of the banks is very apparent and curious. Most of the rock of which they are formed, seemed to me as seen from the boat, to be sandstone. At a considerable distance from Havre, however, the gray carbonate of lime appears, and still farther up, granular gypsum. The rocks all lie in strata nearly horizontal, but of very unequal thickness. I remained but a few hours in this ancient city, famous for its manufactures, its high houses, its narrow streets, and its cathedral, which is exceedingly splendid, and deserves attention from every traveller. After refreshing myself with a good dinner, and taking a bird's eye view of the wonders of Rouen, I posted off, moonlit, for the French capital. There I met some old friends, whom the grave had not yet claimed, and made a few new ones. Paris is not what it was when I saw it nearly thirty years ago. Improvement has made giant strides in every thing—in the pavements of the streets, in the private and public edifices, in the national gardens and squares, and in the royal palaces. I remained in that gay city twenty days only, and then took my place in the diligence for Chalons, on the Saone, passing through Sens, whose archbishop formerly assumed to himself the modest title of "Primate of the Gauls and Germany," to Avallon. This small city stands on a *plateau* of granite, and it is the first granite I had observed *in situ* after leaving Paris. Indeed, the principal rocks which I saw between these two cities, are sandstone, limestone, and gypsum. In the neighborhood of Avallon I picked up, near the road side, several good specimens of ammonite. I reached Chalons at noon, having been imprisoned in the diligence forty eight hours, without regular meals, and without much sleep. Chalons, you know, is the Gabilonum of the Romans—a place of business and bustle, being the great thoroughfare of the merchandize going from the south to the north of France, and to the United States. Steamboats ply daily on the Saone, between this city and Lyons. The river is about half as large as the Connecticut at Hartford. I took passage in one of these *bateaux á vapeur*, for Lyons.

From the water, several ancient towns and cities were pointed out to me, the thrilling tales of the heroic deeds of whose inhabitants I had read in my youthful years, and wept while I read them; savage however, they may be better called, than heroic. Macon drew my eye, and fixed it. Here the innocent Huguenots were drowned by hundreds, by order of the bigoted governor; history tells more of this matter than I wish to remember. The entrance to Lyons on the river is exceedingly delightful; this city rests on a tongue of land, formed by the confluence of the Saone and the Rhone—the Rhódanus of Cæsar, and, Paris excepted, acknowledges no superior in France; its population is one hundred and sixty thousand. A Roman consul founded it forty years before the commencement of our era. Its silk fabrics are known over the whole earth—they are worn by all nations.

I took my departure from Lyons in the twilight of the morning, in a steamboat which descends the river to Avignon; an old city, walled up to heaven, and gloomy, as was the Bastile in 1750, containing the tombs of some of the popes, who once resided here, and the grave of Laura, or at least a monument to her memory, standing in a retired garden, and surrounded by the sepulchral cypress and willow.

The scenery presented to the eye as we moved down the Rhone, could not be too much admired, and yet the country disappointed me. It is less fertile, and more broken, hilly, and mountainous than I anticipated finding it. Over thousands and thousands of acres sterility reigns, and will eternally reign unmolested. Nothing shows itself on the surface but naked, weather-worn rocks, thrown into all imaginable fantastic shapes. But every nook of earth that is tillable, is used to the best advantage; not a yard, not a foot is lost. The sides of even the most precipitous mountains are terraced high up, exhibiting the appearance of a vast *escalier*, each step of which is set with the vine, then sending forth copious, verdant foliage, interspersed with fair promises of an abundant harvest.

The Rhone is wonderfully tortuous in its course, and filled with islands, which materially embarrass its navigation. The water is shallow, and the current rapid, but not broad. In size and importance it is surpassed by many of our New England rivers; at Avignon, it is perhaps half as wide as the Delaware at Philadelphia. "Does the country resemble ours?" No, sir, not much; it is more rocky than Maryland, or Vermont, or Massachusetts. "What is the nature of the rocks?" They are principally calcareous. "How do the mountains differ from the Blue Ridge of Virginia, or from the Green Mountains of New England?" They are more angular, more irregular in their forms—have a much greater number of peaks. These peaks are more acuminated, run higher above the body of the mountain, stand nearer to each other, and seem to have been produced, as I have no doubt they were, by the ejection of earthy matter, partially fused, from a thousand little volcanic craters.

"Is the country more interesting to the traveller than ours?" I think it is. Not that it is wilder, or naturally more romantic, or picturesque; nature has done more, far more, for America. But art, and old age, and superstition, and feudal customs, and volcanic fires, have done every thing here. The ruins of ancient castles, and "deserted chateaux and convents, placed on the pinnacles of craggy rocks," present themselves to you at every turn of the river, as you move down the Rhone. The falling tower, the crumbling statue, the moss-clad mouldering arch, the antique, costly tomb, all tell you, in language that cannot be misunderstood, that hundreds of generations of men have been born here, have toiled and died; that genius, and wealth, and power have dwelt here, and left monuments of their achievements for the admiration of all after ages. Yes, sir, it is the old age of the land—the antiqueness, the gloomy remembrancers of the deeds of days long ago past; it is the granite column, which is uninjured by the wear and tear of a thousand winters—it is the sculptured marble chiselled by hands, centuries since, turned to dust. These, and a host of kindred objects, give the charm, the thrilling charm, to the countries I have passed through, and this charm the new world does not possess.

At noon I left Avignon for Nismes, in the diligence. The ride was delightful—the country better cultivated, and more beautiful than any which my eye had yet rested on. The first two miles were on a gradually ascending plain, covered on all sides, and to a great extent, with mulberry and olive trees. The latter, at a little distance, bear some resemblance, both in size and foliage, to our common willow. They were innumerable; I am confident, that between Avignon and Nismes I passed millions of them; they form, a great part of the way, an almost uninterrupted forest. Wherever the olive occurs, there you may expect to find the vine accompanying it; they occupy the same ground, and flourish well together. This tree is long-lived; some of the orchards I passed were said to be more than two hundred years old. It is not large, never reaching the size of our largest apple trees. The fig tree was seen in that region, here and there, and the almond tree in vast numbers, loaded with fruit, nearly mature.

Nismes, called Nemausus when Hannibal was there, is one of the best built, and cleanliest cities of France. It has a population of forty thousand inhabitants, and is celebrated, as you well know, for its antiquities—its oval amphitheatre, four hundred and forty two feet in length, and seventy in height; its Corinthian temple, and its Roman baths, all in a state of tolerable preservation. I can only say, that every traveller, who visits Italy to see its ancient monuments, ought first to visit Nismes.

My next fifteen miles lay through an almost unbroken wheat field. Few mulberry, or almond, or olive trees were visible, and but little grass. This brought me to a canal, commenced by Napoleon. In a dirty boat, drawn by a single horse, I travelled fifteen or twenty miles; the diligence then took me up, and brought me to Marseilles, where I embarked on board the new and splendid steamboat Phocion, now on her first voyage of pleasure around the Mediterranean. On the first of June we anchored in the bay of Genoa, or Genes, as it is there called, where the city exhibited itself in the most favorable point of light. Indeed, its situation, spread out on the sides of lofty, converging mountains, forming a magnificent semi-amphitheatre, is more eminently beautiful than that of any city I have seen in either hemisphere. Its objects of curiosity are rich and multifarious; its palaces are sumptuously decorated with elegant columns, and statues, and paintings. I looked at them till my eyes were satisfied. This, you know, was the birth-place of Christopher Columbus, the greatest navigator—perhaps I ought to say, the greatest man, the world has yet produced. I searched two hours for his house, but searched in vain. The spot, one told me, where he first saw the light, is on a small stream a mile or two distant from the city.

At the close of the third of June we moved off for Leghorn, which contains little to attract the attention of a man whose object in going abroad is not commercial. I therefore took a trip of fourteen miles to Pisa, a city built soon after the overthrow of Troy; and was nobly rewarded by a view of the Campanile, or Leaning Tower, the Duomo, or church in the form of a Latin cross; the Baptistery, or the edifice in which baptisms are performed, and the Campo Santo, or ancient burial ground. They fill the bosom of the gazer with astonishment; the sight of each of them is worth a journey from Moscow. The Leaning Tower I most admired; it is of a circular form, one hundred and ninety feet in height, consisting of eight stories, and ornamented with two hundred and seven granite and marble columns. I mounted, by an easy, winding staircase to the eighth story, where I had a commanding prospect of Pisa, of a broad zone of land encompassing it, and of many conspicuous objects far distant, among which was Leghorn. It is believed that the tower was originally perpendicular, and that its present declining position was occasioned by an earthquake, or by some other physical phenomenon. You will not allow me to speak of the abode of the illustrious dead, and tell you that it is "a vast quadrangle, surrounded by sixty light and elegant Gothic arches, composed of white marble, and paved with the same substance;" that it contains sarcophagi innumerable, of Parian and Luni marble, ancient vases and rich frescoes, cinerary urns of alabaster, and paintings of enormous size. I must leave the magnificence of the interior of the Duomo—its high altar, ornamented with lapis lazuli, verd antique, bronze gilt, &c.—its porphyry columns, its group of angels, all must be left for you to imagine.

The next pause the Phocion made, was at the little filthy city of Civita Vecchia, whose harbor was built by Trajan, who had a villa in its vicinity. Here she remained eight days, for the purpose of giving her passengers an opportunity to visit the "Eternal City." This period being expired, she brought me to Naples, or Napoli in Italian, which stands at the extremity of my *voyage*. I remained in that city of business and noise eight days, examining its *merveilles*, and those of the region around it; in treading the narrow streets of

Pompeii, and gazing at its untombed wonders, its edifices, its altars, and its gods; in groping my way in the deep and dark theatre of Herculaneum; visiting the lake of Tartarus, now Avernus; the old city of Puteoli, where St. Paul resided seven days; the tomb of Virgil; the Grotto dèl Cane; the Monte Nuova, or New Mount, "formed in thirty six hours by a volcanic explosion of 1538;" the Stygian Lake, the Elysian Fields, &c. &c., or inhaling the sulphurous odors of the still smoking Solfaterra, or in clambering up the lofty, ashes-clad Vesuvius. This being accomplished, and more, I came to Rome by land, travelling on the *Via Appia*, much of whose ancient pavement is yet visible, consisting of stones a foot or more in length, six or eight inches in width, and perhaps as many in depth, and passing near the spot of ground on which the *second* orator the world has produced was basely murdered, and over the Pontine marshes, of which our company felt no dread.

I shall say nothing of Rome, except to remark, *en passant*, that it is far the most interesting city I ever entered. I do not mean *modern Rome*. Burn St. Peter's, and what adjoins it, and young Rome would be infinitely inferior to London, to Paris, to Edinburgh, and to many other cities in Europe. No, sir, it is the old Rome, with which I was enraptured; where Horace was, and Cicero, and St. Paul; where Cato lived, and Virgil sung, and Cæsar bled; where are monuments still visible, which tell the tales of other times, the Via Sacra, the Tarpeian rock, the triumphal arches, the aqueducts, the Coliseum! What a luxury it would be to you, sir, who are an admirer of the Latin classsics, to plunge into this ocean of speaking ruins, and spend weeks and months in it!

A voiturin conveyed me to Florence, over a country of hills and dales, of mountains and valleys, overspread with the best of earth's blessings—corn, wine and oil; a land of figs, and almonds, and pomegranates and olives. I did not sojourn long in this splendid city. The heat was oppressive, and yet not more oppressive than it often is at Washington or Philadelphia. Indeed, the summer heat of Italy is, I am persuaded, quite as tolerable as that of Maryland or Virginia, and the climate not a whit more unhealthy. My stay in Florence was, however, long enough to give me an opportunity to examine most of its curiosities. I early betook myself to the church called "Santa Croce," where repose the ashes of Italy's noblest sons. On one of the walls is placed a simple epitaph over the tomb of that wonderful man, Galileo. On the opposite side are the chaste and beautiful sepulchral monuments of Dante and Michael Angelo. The chisel has here done its best to perpetuate many illustrious names which I cannot now enumerate. The museum is rich in objects of art, and of the natural sciences. I have seen no collection of minerals so large, and so valuable, except that of the Jardin des Plantes at Paris. The galleries in the ducal palace are bewitchingly attractive, adorned with the finest paintings and statues, glittering with the richest articles of furniture, with sumptuous vases, and tables, composed of the most costly and splendid minerals, inlaid, such as malachite, amber, lazulite and many of the gems.

Florence is sometimes termed "the city of palaces," and is rightly named. The palaces are numerous, and many of them exceedingly elegant and capacious. Eleven of them were for sale when I was in the city. Would you know the value of a palace in Florence? At my request, our consul took me to the man, who had the disposal of one of them. It was finely situated, was four stories high; had fourteen apartments, and some of them very spacious, on each floor, or fifty six rooms in all. The price demanded for the entire palace was *seven thousand and three hundred dollars*, or it might be rented for any length of time, for *three hundred and seventy five dollars a year!* I left that noble and lovely city with deep regret, and made my way to Leghorn by land.

Unwilling to prosecute my journey into Switzerland, without seeing Elba, that singular island, celebrated the world over for its mineral productions, and scarcely less celebrated as having been the place of Bonaparte's temporary confinement, I engaged a passage to it in an open crazy boat, as no other could be obtained at the time. The distance is forty five miles. She set off from Leghorn at noon. I spent a sleepless night on the waters of the "Great Sea," having the heavens for my canopy, and a plank for my bed. At six, the following morning, I rejoiced to arrive in this city, Porto Ferrajo, which is finely situated on a broad and safe bay, capable of affording good anchorage for five hundred ships of war, and strongly fortified, containing about seven thousand inhabitants, three churches, one theatre, the *hotel de ville*, and the governmental palace, in which I am writing this communication. This last edifice was in part erected, and was inhabited by Napoleon. The American consul at Leghorn, Mr. Appleton, very politely gave me a letter of recommendation from the governor of Leghorn to the governor of the island of Elba. It procured me the kindest reception, both from the governor and all the officers of the government. I was received into the governor's family, and requested to occupy a chamber in the palace while I remained on the island. This officer is a gentleman of unaffected politeness, of great simplicity of manners, and is much loved and respected by the islanders.

Elba is about sixty miles in circumference, of an irregular oblong figure, its longer diameter running from west to east. Its surface is exceedingly uneven, being thrown into every imaginable shape; there, rising into mountains two or three thousand feet in elevation; here, sinking into deep vallies. Some of the high lands are covered with vegetation, but most of the summits of the mountains are naked, and exhibit nothing but rocks, which a hundred centuries have rendered almost as white as Parian marble. The vallies are productive, yielding grapes in vast abundance, and grain of various kinds, the fig, the orange, the watermelon, (which is here called *cucumber*,) pears, apples, plumbs, &c. &c. The number of inhabitants in the island is about fifteen thousand. They are principally in Porto Ferrajo, and the villages of Longone, Capoleon, Marinna and Campo. There is little wood on the island, and what there is, is a small growth. Jackasses, loaded with faggots, and pieces of wood two or three inches in diameter, are constantly seen coming into Porto Ferrajo from the country. The oak grows here, and the maple, and several other trees, which are common in America: but there is one here that I have not met with before; it is the cork tree, whose bark is thick, and is used for stoppers of bottles, to make lines float on water, &c. I have cut a stick of it, which I shall have converted into a cane when I arrive in Paris.

The geological structure of Elba is different from any other part of Italy. I saw no decidedly primitive country between Avallon in France, and Naples. There may be land of this character in Italy, and the south of France, which I did not see. I infer from what I saw, that the whole country of which I speak, was of volcanic origin: in some places the lava is old, and in others young, but always bearing evident marks of igneous fusion. I have crossed the Appenines twice; once over Mount Somma, one of the highest, where I expected to find primitive rocks, but found nothing but secondary limestone, full of pores, once, doubtless, filled with gas, and a combination of other materials, which nothing but intense heat could have generated. This island presents a curious mixture of primitive and volcanic formations. The rugged mountain which you see at the right hand as you enter the harbor of Porto Ferrajo, has all the appearance of having been ejected from the earth by an internal energy; whereas those massy piles which stand on the south and east of the island, bear no *obvious* marks of fire, although they, too, may have been raised, at a more remote period, by that agent. I have spent a week here, and seen many of the mineral productions. I shall enumerate some of those which I have seen, without any regard to system. There are probably others which have not come under my observation.

1. Rock crystals, of various sizes, from a line in diameter to two inches; all in the form of the hexagonal pyramid at one extremity, and some at both; some diaphanous, as the purest water, and others entirely opaque.

2. Feldspar, crystallized and massive.

3. Tourmaline. It often occurs in the feldspar. I found a vast quantity of it in rolled fragments, lying along the northern shore of the island, and it must have been brought there by the waves of the sea. Some of the balls were nothing but black tourmaline, (schorl;) others were a mixture of this substance with feldspar.

4. Rubellite, in beautiful crystals, but not enveloped, like those of Chesterfield, in green tourmaline.

5. Aqua-marine, not plentiful, but sometimes found.

6. Epidote, crystallized, and in irregular masses.

7. Jasper, red, green, and brown; very abundant.

8. Porcelain earth, or decomposed feldspar, in different parts of the island. The manufacture of this article into porcelain, or China ware, might be made a source of revenue to the government, were fuel more plentiful.

9. Limestone, primitive and secondary, red, white, and sky-colored. The white is capable of being converted into a marble, little, if at all, inferior to that of Carrara. The red, too, when polished, strongly resembles the best of the Rouge Antique of Rome.

10. Arragonite, in the shape of calcareous stalactites.

11. Mica, silver white, green and black.

12. Yenite, jet black and brown, crystallized and massive. The crystals usually occur in groups, which are, occasionally, large and splendid. Formerly, yenite was abundant here, but at present good crystals are rarely to be met with, and when bought of the inhabitants, they are purchased at a high price. I have obtained, by discovery and by purchase, a good number of specimens. A large group

of crystals of yenite was offered to me by a gentleman of this city, who estimated its value at the moderate sum of *three hundred piastres* or dollars.

I have made several mineralogical excursions, on different parts of the island. In one of them only, I will ask you to accompany me. Having provided myself with a guide, the only practical mineralogist on the island, and being furnished with little horses, accustomed to climb mountains—by the way, I had the same pony, as the guide told me, which Napoleon had rode, with a rope bridle, over the same grounds—we first passed the bay, which is two or three miles across. We then ascended a ragged mountain, probably three thousand feet in height, composed chiefly of micaceous schist and jaspery ironstone. On the almost inaccessible summit of this mountain, stand, frowning on the world below, an old tower and fort, built at an unknown period. Descending, we found on the eastern slope the ancient village of Rio, consisting of about one hundred houses. It is placed on a succession of serpentine rocks, both precious and common. We descended into a narrow valley, where the walls, along the sides of the road, were formed principally of serpentine and common jasper. After travelling a few miles further, we came to another mean and filthy village, called also Rio, but to distinguish it from the other village of the same name, and because it is situated on the margin of the sea, it is denominated ***Rio Marina.*** There was yet another lofty elevation to climb, before I could gain a view of the famous mine of specular oxide of iron, to see which was the main object of my visit to Elba. All this part of the island seemed little else but a vast ore bed, made up of the sulphuret, the sulphate, the specular and the magnetic oxides of iron. Winding our way up the mountain by a most zigzag path, we met hundreds of donkies, almost crushed to the ground by the astonishing loads of the ore, in baskets, two tied together and slung across their backs, which they were bringing down to the vessels lying in the harbor ready to receive it. I pitied the poor animals, *imo pectore*, as I have often done before. Indeed, the ass is the animal the most used and the most abused in Italy, always toiling from break of day to dusky eve, willing to eat any thing, and yet always starved; if among the slippery ledges he makes a misstep, he is sure to be lashed for it; and yet is patient and uncomplaining, under all his hardships and cruel treatment.

The surface of the ground, in many places, exhibits a very curious appearance. The sides of the ravines, produced by the force of the water, rushing down from the highlands, look as if they were covered with a thick green moss; but, on approaching, I discovered that the substance was copperas, or the sulphate of iron crystallized. In other places, it is carpeted by nearly pure sulphur. The summit of the mountain is taken off. The removal of an immense amount of the ore, has converted a large area of the highest land into an horizontal plain. On this plain is situated a round building, called the Coliseum, in which visitors take repose, and in which, I believe, an account is kept of the labor performed by the workmen. Near to this edifice is a grotto, in the mine, made by the ancients, in which have been found hammers, wedges, and other instruments, used by them in digging out the ore. The ore is obtained in the same manner here, that it is in America, by blasting, wedges and pounding.

I was a little surprised, on learning that no metallic iron has been obtained in modern times, from this excellent ore, in the island of Elba. The work is done elsewhere, in Sicily, Turkey, and Spain. It is all conveyed to foreign countries in the ore. It was smelted here in old times, but has not been in modern days, nor can it be, for there is no fuel here which can be spared for this purpose, no mineral coal, and next to no wood. After procuring a large variety of specimens of the different substances found in this neighborhood, I returned to Porto Ferrajo, well satisfied with my day's work, but not a little fatigued.

To-morrow I trust a good wind will carry me back to Leghorn, whence I shall, as soon as possible, pursue my course to the snow-capped Alps.

You will, I hope, my dear sir, excuse me for troubling you with a much longer communication than I at first intended.

Yours, most respectfully.

Art. VII.—*Notes on Chemistry, &c.*; by J. W. Bailey, Acting Prof. Chem. &c., U. S. Mil. Acad. West Point.

1. *On a new Test for Nitric Acid.*—Chemical reagents may be divided into two classes; first, those which produce with the substance they are employed to detect, an action which they will produce with no other known body; an example is starch, as a test for free iodine: secondly, those which cause a certain action with a *small number* of bodies, which they will not exhibit with any others; as, for example, sulphuretted hydrogen, which causes a black precipitate with a *few* metals.

The first class are, of course, the most valuable reagents, as they require no subsequent operation to determine whether certain substances are present or not; while with those of the second class, we only determine that one of a certain number of bodies must be present, but must then resort to other means to ascertain which particular one it may be.

There are many cases, however, when we may know that only one of those bodies which are capable of giving similar results with the reagent added is present, and then if this result *is* produced, the evidence is as satisfactory as can be desired.

The test which I would propose, must be placed among those of the second class, and is therefore inferior in value to morphia as a reagent for nitric acid; but I think it *at least* as valuable as the method by means of gold leaf and hydrochloric acid, or by the bleaching of indigo.

The substance I now suggest, as a new reagent for nitric acid, is the cyano-hydrargyrate of iodide of potassium, discovered by M. Caillot. It is formed by mixing together bicyanuret of mercury and iodide of potassium, (one equivalent of each,) dissolved in small quantities of warm water. It soon crystallizes in a very beautiful manner. This is the same salt which has recently been recommended as a means of detecting the presence of hydrochloric acid in hydrocyanic acid. (See Lond. and Ed. Phil. Mag. Nov. 1835.)

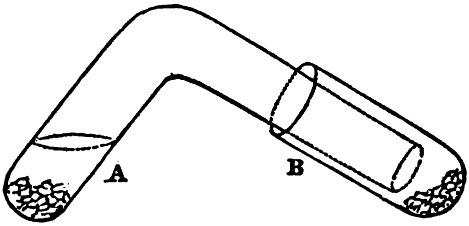
Its use as a test for nitric acid depends upon the fact, that if one of the scale-like crystals be introduced into *most* acids, it immediately becomes of a beautiful *red*, being changed into the bi-iodide of mercury; while in *concentrated* nitric acid, (spec. grav. 1.4 to 1.5,) the scale instantly becomes almost black, from the liberation of iodine.

A scale of the salt introduced into a drop of the acid no larger than a pin's head will show the effect distinctly.

The acids in which I have found the salt to *redden* are, sulphuric, hydrochloric, hydrofluoric, chromic, phosphoric, (if slightly diluted,) and the common vegetable acids, such as oxalic, tartaric, citric and acetic acids.

I have found it to blacken with chlorine gas, solution of chlorine, (recently prepared,) bromine, sulphuretted hydrogen, nitrous acid vapors, and *nitric acid.*

It is highly probable, that it would be blackened by bromic acid and chloric acid, and possibly by iodic acid, but I have not at present these acids in a free state to determine their action; the method, however, in which I use the test will prevent any fallacy from the presence of chloric, bromic, iodic or chromic acids, and of sulphuretted hydrogen. It is to evaporate the supposed nitrate to dryness, and introduce into a tube retort A, (see the figure,) a small portion of the salt, on which a few drops of sulphuric acid are to be poured; then on applying moderate heat, by means of a spirit lamp, a portion of the volatile products are to be driven over into the receiver B, in which a few scales of the salt are previously placed. If these are blackened, the salt is to be considered as a nitrate, provided the presence of those few substances which might cause the same result has been guarded against. Now by the very method proposed, viz. evaporating to dryness and adding sulphuric acid, the presence or absence of chromic, chloric or iodic acid and sulphuretted hydrogen will be determined; for the color of a chromate, the evolution of peroxide of chlorine from a chlorate, the liberation of iodine from an iodate, and the odor from a sulphuret, will at once decide with regard to each. As iodic and bromic acids, even if they are found to blacken the salt, are not sufficiently volatile to be driven over by the heat to be employed, no error could arise from their presence.



I have observed, that if the salt used above, or the bi-iodide of mercury itself, be introduced into a test tube, with strong sulphuric acid, on adding a concentrated solution of any nitrate, (except those of silver and mercury,) the red color of the scale or bi-iodide will speedily disappear, and will be followed by the dark hue of iodine. Even when the sulphuric acid forms an insoluble precipitate, the action may be seen, by stirring up the precipitate with a glass rod, when the dark spots will be easily observed.

This method of testing may sometimes be used, but is liable to the objection that a chromate, chlorate, and probably some other salts, would give the same result. It is greatly inferior to the method by distillation, as given above.

2. *Locality of Hyalite at West Point.*—Last autumn I noticed at a quarry of gneiss on the shore of the Hudson, about a quarter of a mile below West Point, a beautiful incrustation on some of the masses of gneiss which had been removed from situ by blasting. On examination by the microscope, and by analysis, I am satisfied that it is Hyalite, although gneiss is I believe a very unusual situation for this mineral.* The mineral forms a crust of about the thickness of one or two wafers, upon what appears to have been a natural seam of the rock, and it does not appear to have been produced by any decomposition of the surrounding mass. Its color is white; lustre varying from silvery or pearly to glassy. When examined by a magnifier it is very beautiful, presenting a brilliant collection of small mammillated masses, in some places opaque, and at others transparent as glass. By analysis it gave about 84 per cent. of silica, 6 per cent. of alumina and oxide of iron, and 10 per cent. of water.

Specimens are sent with this; those in the paper marked (A) show the mineral in its purest state.

On the same surface with the above, and apparently passing into the same, was a silicious crust, which by the magnifier showed no signs of the mammillated structure, nor any lustre, but small elevated straight lines, about one fourth of an inch in length, were observed, crossing each other in various directions, and indicating an imperfect crystallization. A specimen (B) showing this character is also sent.†

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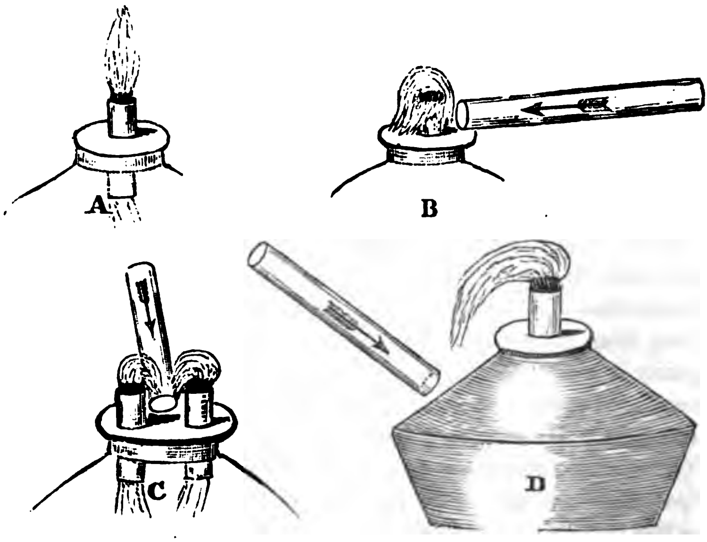
* It is found in the gneiss at Haddam, Conn., in exactly similar form and circumstances.—Ed.

† Not received, Jan. 26, 1837.—Ed.

3. *Curious effects of a current of air on the flame of lamps, &c.*—The singular change of direction produced by introducing into the axis of an Argand burner a jet from which a current of air is forced, of which an account is given in the Lond. and Edin. Phil. Mag. for November, 1835, led me to notice some effects of currents of air on the flame of a common lamp. If a small tube, of the size of the barrel of a quill, be blown through strongly with the mouth, while in the positions shown in the figures below, the flame of the lamp will be drawn from its course *towards the orifice* of the tube in a very singular manner. The figures show some of the results.



A, the flame before affected by a current.

B, C, D, position of the flame under the influence of the currents.

These effects evidently depend for an explanation upon the same principles as the well known experiment with a tube and disk.

West Point, Nov. 26, 1836.

Art. VIII.—*A Visit to the Salt Works of Zipaquera, near Bogota, in New Granada*; by J. H. Gibbon, M. D.

On the 11th of June, 1836, I accompanied the gentleman who has the management of the Salt Works at Zipaquera, to visit that place, a distance of thirty miles from Bogota; which distance we cantered over in five hours, passing along the skirts of the mountains at the foot of which the city is built, and through the rich plain, watered by the river of Bogota, whose banks were covered with fine cattle of various kinds, while lively patches of corn, wheat, barley, potatoes, and artificial grapes, protected by Indian boys and girls from the depredations of the four footed creatures which grazed under their charge, were seen to surround the villages of low Indian huts; some of which, situated in the midst of this cultivation, are nearly concealed by trees and flowers. A few large country seats, built by the Spaniards, appeared at intervals upon eminences at the base of the hills; they are now seldom frequented by the proprietors, who prefer to live in the city; their estates are left to the care of managers, being principally employed for grazing; the cattle are said to thrive and fatten very rapidly upon them, being restrained from wandering by an enclosure of substantial stone walls. I had an opportunity of seeing the very slow and tedious process of repairing roads—an art itself altogether curious in that country; being apparently, to judge from experience of their condition, very seldom attempted. A pair of oxen were fastened by ropes to one corner of a large hide; this being drawn to the side of a hill, was filled over with earth and stones; the corners of the hide were then tied together, and the rubbish was dragged upon the ground in this strange vehicle to the spot where it was needed.

Zipaquera is an old Indian settlement, and now contains about eight thousand souls. The salt works are managed upon the same general plan pursued by the natives before the conquest, for calcining and hardening the salt, that no injury or loss might be sustained by heavy rains, in its transportation to distant stations, or in passing rivers intercepting the roads.

Upon the mountain directly above the town is exposed a huge rock of salt, of a dark lustrous color, interspersed with crystals of a purer white, called *palamos*, bleached also in streaks by the filtration of water and heat of the sun. Between the main body of salt and two distinct strata, each several feet in thickness, which lie above it, inclining at an angle of about 45°, there is a dark colored, unctuous hard clay, among which there are found pyrites, called by the natives *marmajos*, some of which are compact and unique; others, in smaller crystals, spread out upon the hard earth, form a congeries of small sparkling bodies, which have a very brilliant appearance when cleansed; these are sometimes wrought into ornaments—they look like diamonds by candle light; other specimens resembling gold are occasionally ground into powder, and used as sand upon writings.

Very near to the salt rock appears a deposit of fine limestone, called *yeso*, made use of about the altars of the churches, like stucco work, and for white washing. Sulphur is also indicated about the mine; the salt is said to contain a considerable quantity of it.

The masses of salt are dug from the rock by means of crow bars, and in its impure native state, is bought by the people of certain districts of the country, who thus prefer it; while others will purchase it only after being purified and hardened by calcination, although the price for both kinds is now the same. The consumption of grained salt, made in pans or *calderos*, is very trifling; the salt undergoes this process of crystallization before it is calcined; and it was supposed that the ability and desire on the part of the Company to supply grained salt at a lower price would increase the consumption of it, especially in the vicinity of the works. But "ancient custom" has still more influence with these people than any arguments of special or political economy; and arrangements which are well appreciated elsewhere, have often no sort of influence upon their minds, in comparison with former prepossessions. Some years ago the price of the rough natural rock salt, in the state in which it was dug from the mountain, was suddenly reduced, the expense of cutting it out being trifling compared with that of the process for calcination. As one portion of the population gave it the preference, it was presumed the consumption of it might be augmented in other districts; but the people who had formerly purchased this kind in preference, could not understand the sudden decrease in its value, and were prejudiced to believe that the salt was "rotten," as they said, or that there was some peculiar cause not apparent to them, and therefore suspected why the reduction took place; so that the Company found it better to keep the price at the former rate—there was then no diminution in the consumption. The abstract reasonings of political economy, it appears, must have reference always to the condition and information of those among whom its principles are to be applied.

The impure salt taken from the rock is principally used to strengthen the water from the salt springs which rise in its neighborhood, and contain from ten to eighteen degrees of strength; the point of saturation being twenty five degrees, regulated by an instrument graduated for that purpose. I was told that after various experiments it was found, that water at any degree of temperature would not take up more than one fourth of its weight of salt.

The water from the salt springs is received into a large basin of substantial mason work coated with cement, built in the time of the Spaniards; large lumps of the rock salt are cast in to saturate it, after which it is drawn off to be filtered into large earthen pots containing from seven to fifteen gallons, arranged in an arch of a very peculiar construction over a furnace heated by wood and bituminous coal, found in large quantities in the vicinity. From one hundred and sixty to one hundred and eighty earthen pots of a sugar loaf form, are arranged in an arch over the furnace, (which is a large, square apartment, like an open shallow cellar,) in lines beginning at each side, being supported below by the faggots and coal, and at the sides by unburnt bricks plastered with clay, which fill up the interstices between the pots, leaving here and there, apertures for the smoke to escape; after the first four hours of the process these apertures are closed up. When the rows of pots approach the center, a row of the largest size are ranged in the middle like key-stones to an arch, and the whole fabric is supported by lateral pressure, after the wood and coal which at first serve as a resting point, have burnt away and consolidated the clay which is dashed in between the sides of the pots.

The saturated salt water is at first thrown into the exposed mouths of the pots in small quantities, as a glaze; they are then gradually filled up with grained salt, prepared in the ordinary manner in large iron pans. For twenty four hours after, salt water of the highest grade of saturation is thrown in occasionally, (the mouths of the range of pots being reached by calabashes fixed to long handles,) in order to consolidate the texture throughout the mass in the pots. Fresh wood is cast into the furnace underneath the arch for twenty four hours, and the pots are left in their position for forty eight hours afterwards, to receive the heat of the cinders, which are occasionally raked up. This continued heat of seventy two hours renders the salt of a marble-like firmness and appearance; being glazed on the exterior in a manner to render it capable of resisting rain, or the water which reaches it when carried across rivers upon mules, its form being well adapted to this mode of transportation; the large loaves of salt are slung upon each side of the pack saddle. When the salt is sufficiently calcined and cooled, hundreds of poles or faggots are placed underneath the pots to receive their weight, and serve as subsequent fuel; the arch is then broken down, and the earthen ware, which adheres very closely to the salt, is cut off by a crowd of Indian women with chisels and mallets. These women are allowed as their perquisite, to take away the broken pottery, to which some salt necessarily adheres; they steep the earthen ware in water, and the saline solution is sold by them for purposes of cooking; they sometimes also attempt what is considered a contraband, by boiling and granulating it in their huts; for salt is a monopoly of the government, which formerly rented out the whole supply for a certain annual income, but now pay a company a fixed price for manufacturing it, on account of the revenue. The springs and mines are therefore carefully watched to prevent private interference.

When the "Salt Company" first undertook these works, there was much illicit working at the springs, and the agents were obliged to interfere with those who were employed in the contraband manufacture, breaking their pots and pans, and seizing the salt; the consequence was the murder of several foreigners engaged at the works; and for several years the greatest animosity prevailed between the parties. Some judicious alterations attaching the burthen of protection and seizure upon the government, and not upon the Company, and the encouragement of various industry connected with the legal manufacture, have at length caused a cessation of the hostile feelings.

The Company is now allowed 2½ reals, (31¼ cents,) for manufacturing each arroba, (25 lbs.) of salt; to this amount the government adds a charge of 4 reals, (50 cents,) per arroba, more. It costs then the consumer, or trader at the works, $3 25 per one hundred pounds, of the calcined salt; the expense of transportation is very great, and therefore the consumption is, as much as possible, economized.

When the Company farmed the rents, it paid to the government $19,133 per month, nearly $230,000 annually. Last year the government paid the Company $118,000 for making four hundred and sixty thousand arrobas of calcined salt, and derived a nett revenue of about $250,000 from its sales.

There are two establishments under the direction of the same Company. I was informed that all the salt springs in New Granada lie nearly within two straight lines, forming an obtuse angle with each other at a point where one extremity of each strikes a range of the Andes, beginning near Popayou and terminating at Chita, near the plains of Casinare, a distance of more than three hundred miles. Some salt springs are found at a great elevation in the Andes, and others in the valley of the Cauca.

The salt springs at Zipaquera are all cold; those at Chita, a distance of five days' journey, or about forty leagues, are almost all boiling hot. The cold springs are found strongest with salt; but Chita is more exposed to rains, (the rainy season continues seven months,) these are said to dilute the springs, and thus reduce the average strength of the waters. On our way to Zipaquera we passed a great number of Indians—men, women, and children, bearing upon their backs long bundles of poles, or faggots, which are sustained in that position by a bandage passed over the forehead. They bring their wood a considerable distance to the salt works for a price varying from three quartillos, or nine cents, to one real, or twelve cents, each bundle. Although coal could be advantageously used to a greater extent, it is thought judicious to encourage the industry of the people in their own way, for it can with difficulty be drawn into other channels than those they have been long accustomed to.

Upon one occasion there was a great demand by the company, who wished to extend their operations, for the earthen ware pots in which the salt is calcined: these are made altogether by the Indians. The gentleman who had charge of the works, in order to effect the supply, as he thought, offered double the usual price for these necessary articles; still there was a great deficiency. In this dilemma he applied to the priest of the parish to aid him with advice, and to know what plan he should pursue to obtain the required number of pots for the work. The padre, having heard the fact of the payment of an increased price for the pots, shook his head, and observed, that since the people received so much more money than formerly for their labors, they occupied their time in spending it, instead of making more pots. He advised that the price, which was originally three medias (18¾ cts.) for each pot, and had lately been increased to three reals, (37½ cents.) should be *lowered* to three quartillos, (9 cents.) The plan was tried, and the stores were soon found filled with a superabundance of earthen ware.

The gentlemen who have charge of the salt works are aware of the very rude manner of conducting the processes, but the want of artizans, the influence of ancient customs, and deficiency of scientific and other practical information, induce them to adhere to the old plan. Some of those however who have an interest in their works, propose to establish, at some short distance, a forge and foundery, ultimately to supply iron pots, with contrivances to allow the escape of the loaves of salt after the processes of calcination.

Although the impost of the government is so high upon the manufacture of salt at the springs, that procured by evaporation on the sea coast is not subject to any duty ; and foreign salt has been permitted to enter almost free, until the last session of the congress at Bogota, when a duty of eight rials (one dollar) for every hundred lbs. was imposed.

The state of the roads in New Granada, inaccessible for the most part to wheel carriages ; with its rapid rivers, navigated almost solely by canoes, makes transportation so expensive, that with the high price created by the government monopoly, salt is much economized. Strangers find themselves obliged to carry a lump of salt with their baggage, to add to the very scanty seasoning of it usual in the cooking. A salt cellar is by no means thought an indispensable part of the table equipage, and in many instances it will be in vain called for. A North American vessel was found at Buenaventura, on the Pacific, with salt brought from the Sandwich Islands: this, inclosed in hides, was conveyed up very rapid rivers into the interior, although by nature so extensively and amply supplied with it. Some of the medical gentlemen in the country are inclined to believe that the deficient use of salt has a tendency to promote the *goitre*, a disease which prevails very extensively in some districts, and for which iodine internally, and frictions with sea water and Aceyté de Sal,[*]

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[*] Dr. Cheyne, of Bogota, a highly esteemed English physician, gave me the following analysis of the Aceyté de Sal, compared with that of sea water :

	Aceyté de Sal.	*Sea Water.*
Water,	0.7064	0.9691
Hydrochlorate of soda,	0.1527	0.0218
" " magnesia,	0.0450	0.0049
" " lime,	0.0930	0.0008
" " potash,	0.0002	traces.
" " iron,	0.0027	——
Hydriodate of iron,	traces.	——
Sulphate of soda,	——	0.0034
	1.0000	1.0000

oil of salt, which drains from the rock salt, have been used with advantage. Whatever may be thought upon this subject, there appear to have been, from ancient date, very decided opinions upon the utility of the general use of salt, which is craved with great ardor by many animals. It is the well known token of hospitality and confidence among the Arab tribes, and the ancient Hebrew moral law enjoins its employment as a point of religious as well as of physical propriety.

It is hardly possible to appreciate the value of such an article, until one has suffered the miseries of privation.

ART. IX.—*Meteorological Journal, for the year* 1836, *kept at Marietta, Ohio, in Lat.* 39° 25′ *N. and Long.* 4° 28′ *W. of Washington;* by S. P. HILDRETH.

Months.	THERMOMETER.				Fair days.	Cloudy days.	*Rain and melted snow.*		Prevailing winds.	BAROMETER.			
	Mean temperature.	Maximum.	Minimum.	Range.			Inches.	100ths.		Mean.	Maximum.	Minimum.	Range.
January,	31.30	63	-10	73	17	14	2	55	W. & N. W.	29.53	29.70	29.00	.70
February,	27.23	56	-18	74	14	15	1	80	W. N. W., S. & S. E.	29.55	29.80	29.00	.80
March,	36.23	62	3	59	17	14	2	80	W. S. W., E. & S. E.	29.43	29.80	28.65	1.15
April,	44.24	89	22	67	18	12	3	87	S. S. E. & E.	29.45	29.70	29.00	.70
May,	65.76	90	38	52	20	11	6	63	S. S. E. & E.	29.37	29.65	29.10	.55
June,	69.66	88	48	40	20	10	2	04	S. E., E. & S. W.	29.35	29.55	29.20	.35
July,	75.20	86	56	30	22	9	3	92	S. S. W. & N.	29.41	29.70	29.10	.60
August,	69.80	85	48	37	20	11	3	16	E. S. E. & N.	29.43	29.55	29.15	.40
September,	68.08	88	38	50	20	10	3	16	S. S. E. & S. W.	29.37	29.65	29.10	.55
October,	45.32	76	22	54	16	15	2	08	W. N. W. & S. E.	29.41	29.70	29.10	.60
November,	36.90	75	12	63	17	13	2	50	N. N. W. & W. S. W.	29.42	29.82	29.05	.77
December,	30.70	54	6	48	18	13	2	25	W. S. W. & N. W.	29.52	30.00	28.75	1.25
Mean,	50.03				219	147	36	75		Mean range, 29.44			

Remarks on the year 1836.—The same diminution of mean annual heat, which has prevailed in the middle and eastern states for the last three years, appears still to be continued, and in the year which has passed at rather an increased ratio. To what cause or

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A Spanish physician of reputation at Bogota, assured me that dogs and cats were occasionally subject to *goitre*, and that he had seen instances in both, although he was not aware that it prevailed among any other domestic animals. Whether some clue to its origin and causes may be discovered by the fact that those animals which feed upon the offals of our table, are alone affected by this peculiar disease, is yet to be shown.

causes we are to attribute this series of cool years, is a mystery as yet hidden from mortal ken, although without doubt it arises from the fulfilment of uniform and fixed laws in the regulation of the seasons. The succeeding series of years will most probably restore to the earth the usual amount of heat experienced in former periods. The mean annual temperature for 1836 stands at 50.03°, which is nearly four degrees below the mean heat for this part of the valley of the Ohio, as ascertained from observations made a number of years since, and is more than half a degree less than the year 1835, which was considered an extraordinary cold year. On the 28th of January the mercury fell to —10° below zero, and on the 5th of February following to —18°, an excess of cold very unusual in this climate. It seems to have pervaded the whole northern continent, and on the lower Mississippi was very destructive to exotic trees and plants, which usually support the winters of that climate without injury. On the Atlantic coast of the eastern states, the cold was more intense and longer continued, than in any year since the winter of 1779–80. At that time the inland sea, called the Sound, between Long Island and the main, near Norwalk in Connecticut, was so frozen as to bear the weight of a man, who deserted from the British troops and came over on the ice. It was now so covered with ice as to put a stop to navigation. Boston harbor was also closed, and many points about New York so frozen as to bear loaded teams, at places not obstructed in this manner since the days of the Revolution. In Ohio, the effect on fruit trees, whose vessels contain a gummy juice, as the plum and the peach, was very disastrous, freezing them so hard as to split the wood and bark into long seams, through which the sap exuded the summer following.

The mean	temperature,	for the winter months, is	29.74°
Do.	do.	for the spring months,	48.75
Do.	do.	for the summer months,	71.55
Do.	do.	for the autumnal months,	50.10

The mean for the winter is only a fourth of a degree less than that of 1835. That of the spring months is nearly three degrees less, while that of the summer is two and a half degrees greater, than that of the preceding year, and that of the autumnal months is two degrees less. The cold in the spring was continued later than usual, while the heat of autumn disappeared much sooner, especially in October and November, each of which months was more than eight degrees cooler than those of the preceding year. The peach bloomed the 26th of April, and the apple the 1st of May, which was about the same as last year, although there was very little progress made in vegetation until the last week in April, when the weather set in with the warmth of July, bringing forward the unfolding of leaves and flowers with the rapidity of a Russian summer. It exceeded any thing I have ever witnessed in Ohio, and clothed the naked trees, in the space of six days, with the beautiful garments of spring. The mean of the summer months being two and a half degrees greater than that of the former year, ripened the wheat at the usual period, that is, about the 4th of July. Other grains and fruits were also forwarded in their growth as rapidly as usual, so that they were perfected before the setting in of frosts early in October. September was with us warmer than common, the mean heat being eleven degrees greater than that of the year 1835, at which time the Indian corn suffered from the early cold in a similar manner to that of New England in 1836, while here no frost was seen during the whole month. The heat of the autumnal months being considerably less than usual, abridged to a few days the weeks of beautiful "Indian summer" weather, formerly so common to this region. The amount of rain and melted snow is 36.75 inches, which is below the annual average at Marietta. We have had more winds from the easterly points of the compass, than in any preceding year since I have kept a regular diary of the weather, which is twelve years. What effect this may have had on the temperature is unknown. The fluctuations in the mercurial column of the barometer have been greater than usual. It was at the lowest on the 10th of March, when it fell to 28.65 inches, during a gale of wind and rain from the S. W. The greatest elevation took place on the 22d of December, rising to 30 inches, wind N. W. This is higher than I have before seen it, by a few hundredths of an inch, making the extreme range one inch and thirty five hundredths for the year. Snow fell to the depth of four inches on the 16th of December, but melted away in a few days. The Ohio river has been partially covered with floating ice since the last of November, and for a few days in December was frozen across at particular bends, with open spaces between. It is now open, but crowded with floating ice.

Disease amongst shell fish.—One of the most curious phenomena of the year has been the fatal effect of an epidemic disease amongst the molluscous animals or shell fish of the Muskingum river. It commenced in April and continued until June, destroying millions of that quiet and retiring race, which people the beds of our streams. As the animal died, the valves of the shell opened, and decomposition commencing, the muscular adhesions gave way, and the fleshy portion rose to the surface of the water, leaving the shell in the bed of the stream. As these dead bodies floated down with the current, the heads of islands, masses of fixed drift wood, and the shores, in many places, were covered with them, tainting the air in the vicinity with putrid effluvia. The cause of the disease amongst the shelly race, remains as much a mystery, as that of the Asiatic cholera amongst the human family. It might possibly have arisen from the slight change made in the quality of the water, from the addition of marine salt, from the numerous salt furnaces now in operation along the borders of the river, the bittern of which, and more or less of the salt water, is daily mingling with the stream. Even a slight change in their vital element, might produce disease and death amongst molluscous animals; as in the atmosphere, fatal diseases fall upon man, from trifling contaminations.

Marietta, Jan. 2, 1837.

Art. X.—*Remarks on some of the Gold Mines, and on parts of the Gold Region of Virginia, founded on personal observations, made in the months of August and September,* 1836; by B. Silliman.

As these remarks cannot lay claim to the character of a general summary, (since they were founded on local, although somewhat numerous observations,) perhaps there can be no better course, than to give an abstract of some of the most important reports that were made on the occasion, to different mining companies.

To those who are anxious to be correctly informed, this procedure will afford a fair view of facts, as they were presented to the eye of an actual observer and enquirer; while reference for more general views may be had to the Report of the Geological Reconnaissance of the State of Virginia, by Prof. William B. Rogers, and to the more detailed account which may be given by that gentleman, when his geological survey shall have been finished.

Some details of topography and of machinery, and other local facts, are preserved in these reports, because—although they may not interest the general reader—they will serve to give a more precise idea of the actual condition and value of some of these mines, and of the promise they afford of being pursued with advantage.

Moss and Busby's Mines,[*] *in Goochland County, belonging to the Richmond Mining Company.*

The gold in the above named mines is contained in quartz. In this respect, with a single exception, they resemble all the other gold mines which I have seen in the gold region of Virginia, where the gold is in place. The rocks in which the quartz is imbedded are decidedly primary, and belong to the slaty family. Those which I have seen are generally varieties of mica slate, passing occasionally into argillite and the subordinate varieties of chlorite slate, talcose slate, hornblende slate, &c. Among these, as far as I have observed, mica slate is most predominant; and much that is here usually called talcose slate, appears to me to be mica slate. It is indeed often shining and smooth in its scales, but it wants the soapy feel that distinguishes talcose slate. The gold is therefore (as far as I have seen) to be referred, primarily, to the mica slate formation. The usual schistose or slaty structure and stratified arrangement of this rock, are here conspicuous. As is commonly the fact elsewhere, its position is inclined—frequently at a high angle with the horizon; forty five degrees, and more or less in different places. The rock is, in general, partially decomposed; almost always it is shivered and crumbly, and often to such a degree as to form earthy banks—soil above—clay farther down, and still lower exhibiting the lines of stratification and structure belonging to the original rock, but so soft as to be easily picked to pieces or cut.

The quartz in which the gold is contained is, in this region, usually spoken of as being in veins. It is perhaps not expedient to object to language that is in general use. It may, however, be proper to remark, that, in strictness, veins intersect and cross the strata at various angles; most metals are found in that situation, engaged in some material different from the rock; this material is called the matrix or gangue of the metal, and it is usually more or less crystalline in its structure, frequently affording the beautiful crystals that adorn the cabinets of mineralogy, such as rock crystal, fluor spar, calcareous spar, sulphate of barytes, &c.

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[*] About fifty miles from Richmond and from Fredericksburgh.

Since my observations were made, I have seen, *for the first time*, the remarks of Professor Rogers on this point; he regards these as true veins of injection; his observations having been more extensive than mine, it is certainly possible I may be in an error; I can speak only from what I have seen. The auriferous or gold-bearing quartz of the gold region of Virginia (and, as far as I am informed, of the States farther south) forms, not strictly veins, but rather beds or layers—in general not interfering with, but conforming to, the regular structure of the slaty rocks of the country, and like them, descending to an unknown and probably an unfathomable depth. There is therefore no probability that the quartz will ever be worked out to the bottom or exhausted, or that it will often be found heaved or displaced by fractures and dislocations, usually called faults, except so far as this accident may have befallen the rocks themselves. This structure makes the working of these mines very simple; the miner follows, unerringly, the bed or layer of quartz; it is rarely diminished to strings or disappears, and when that is the fact, it often reappears at no great distance, in an enlarged size. The quartz is, therefore, as regular a part of the structure of the country as the slaty rocks themselves, and when it is auriferous, (as is not unfrequently the fact in the gold region,) the gold is disseminated through it in spangles, flakes and points, sometimes visible on breaking the quartz, but most usually entirely invisible, even with a powerful magnifying glass. In far the greater number of cases, the eye detects nothing but quartz, or sometimes metallic sulphurets of iron, zinc or lead; and the observer, unless previously instructed in the case, would never suspect the presence of gold, either distinct, or in the metallic sulphurets. The gold, being generally disseminated in the quartz of this gold region, it is obvious that it must have been laid by in its stony bed, at the same time that the quartz and the slaty rocks in which it is contained were deposited. This fact increases the probability that the gold will not be exhausted; no one can indeed predict with certainty, to what depth it descends or in what proportion it exists below; but no reason can be assigned, why it should cease or be found in less abundance than near the surface. The same causes would appear to have been in operation—at the same geological epoch, from the Gulf of Mexico, through the gold region, quite to Maryland—perhaps quite to Lower Canada, and possibly still farther, as some facts would appear to indicate. Gold has been found in Vermont, Massachusetts, and Lower Canada, and, *as is reported*, in New York, New Jersey, Pennsylvania, and Maryland.

The nature of this report precludes discussions of geological theory, and the omission is of the less importance, because the origin of metallic veins and deposits is still, to a degree, obscure, and the clear light which now illuminates most topics of geology, is here, to a degree, wanting; nor would it be pertinent or profitable to recite the various hypotheses that have been, or are still entertained. It is however worthy of remark, that whether the quartz veins are, as Prof. Rogers supposes, true veins of injection, or original members of the rock, the probability of their continuance, and of their continuing to be auriferous, is equally great.

The mines now under consideration, belong to what are called the vein mines, in contradistinction from the deposit mines. The latter contain only alluvial gold, or gold, at least, disengaged from rock or vein stones; it is obviously not in its original connexion; it has, doubtless, proceeded from the destruction of regular veins or beds, and of the rocks which contained them; the gold has either remained mixed with the ruins of the rocks and the veins, or it has been transported and scattered, sometimes far and wide, by the moving power of water, and buried at depths more or less considerable, in loose materials. Sometimes the gold is found immediately under the turf or soil; this happens, most frequently, on hills, but more commonly it lies in lower situations under several feet, or even yards of soil, clay and gravel, and it is most abundant next to the slate, which underlies the whole of the loose materials, and which slate is sometimes soft, being in a state of decomposition. Where the slate rocks are solid, and their strata stand nearly perpendicular, the gold has been sometimes found in the crevices between the natural layers of rock; at the Whitehall mines, in Spotsylvania County, the gold extended downward in this manner, sometimes to the depth of three feet. It should be remarked, that in the regular vein mines, the gold is not confined entirely to the solid qnartz; it is sometimes found in the slate, and both the rock itself and the soft matters proceeding from its decomposition, are occasionally washed for gold, with advantage.

The largest masses of gold have been discovered in or near rivulets, or brooks, or runs of water, called in the language of the country, branches. In such situations, pieces have been found weighing several ounces, and in North Carolina several pounds. On a branch at the Whitehall mine, gold of the value of $10,000 was found in the course of a few days, in a space about twenty feet square, and $7,000 value of gold was found at Tinder's mine, in

Louisa County, in the course of one week. It happens not unfrequently, that the vein mines are discovered in consequence of washing the earth, particularly in the branches.

Busby's Mine.—This mine is wrought in solid quartz. A shaft has been sunk to the depth of fifty seven feet, and it is intended to sink it to seventy feet, until it strikes the vein at this depth; this vein is the first or the most easterly in the series. The thickness of the quartz, as ascertained by excavating it between the strata of rock in four proof pits, which have been sunk to the depth of from twenty to twenty six feet, averaging twenty two feet, is from twelve to thirty inches, averaging from fifteen to eighteen inches. In consequence of the influx of water, it has become necessary to erect a steam engine at the shaft; the machinery is now at the place, protected by a good framed engine-house, and will be soon in operation; this, it is expected, will effectually drain, not only the shaft and the vein to which it leads, but the other veins also, which have been already excavated, and will moreover serve to work the mills. The whim* at the shaft and all the machinery connected with it, are well sheltered by a good framed building. There are also temporary log tenements for the accommodation of the superintendant and his assistants and laborers, and there are abundant materials at hand for the erection of other buildings whenever they shall be needed. The quartz in Busby's mine is very firm—its structure is coarsely granular, and it considerably resembles coarse loaf sugar; indeed, at the mine, it has been significantly called sugar quartz; much of it is, apparently, free from all foreign matter, except the inherent gold, and it is so white that even when pulverized, it shows no tint of color.

The quartz, with its included gold, is, at the mines, universally called ore. Strictly, the word ore should be applied only to *the metal* of beds and veins, and especially to those combinations of metals with other substances, e. g. with sulphur, oxygen, &c., by which their properties are more or less disguised; and it is a liberty of speech, to make it include also, the stony matrix or gangue which encloses the metallic substances that form the proper ores. From necessity I shall adopt the language now in general use in the gold region, and I will, therefore, in compliance with general custom, call the auriferous quartz, *ore of gold.*

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* A technical name for the machine that winds the rope.

In general, the auriferous quartz or gold ore of Busby's mine is destitute of any metallic appearance, the pieces which, on fracture, present metallic gold, being but a very small part of the whole. Hence the surprise and delight of the spectator are very much increased, when he sees the precious metal evolved by very simple processes. I would here observe, that to obtain this, (the only decisive result,) all necessary precautions were, during my investigations, adopted to prevent error. Imposition is, indeed, spoken of, and is said to have been practised in some cases. It is however but justice to the respectable gentlemen and master miners, with whom I was conversant in all these trials, to say, that their conduct appeared to me uniformly upright and honorable, and I believe there was neither disposition nor opportunity for fraudulent practices. There is no reason whatever to doubt that the results, about to be stated in the case of both the mines, were correct; if there were any error, it was in stating the gold too low, as it is certain, that after every precaution, some of it was lost in the washing; still, it is not to be expected that a more favorable result will be obtained in the large way, even supposing that the quartz should, in the progress of working the mines, continue equally rich in gold, as the pieces that were tried; and for practical purposes (aside from science) it is always desirable that trial-processes should, in their results, as nearly as possible, resemble those that may be actually used in the large way.

The quantity of ore which has been accumulated at the Busby mine, and which now waits for the final operations for extracting the gold, was estimated by the underground captain of the mines, at twelve or thirteen thousand bushels. From a large heap, some pieces of quartz were taken at random. They were carefully examined by a good magnifier, and not a particle of gold or of any other substance, except the quartz, could be discerned. Portions were knocked off from each, and were pulverized and sifted. Of this powdered quartz, in which, during the pounding, only a few points of metallic gold became visible, six pounds were taken and washed in an iron pan in the usual way; the matters that were carried into the tub, (used as a recipient,) were washed several times, and gold, although in decreased quantities, was, in every instance, obtained from them: all these portions of gold were then amalgamated with mercury, which had been strained through leather; the amalgam was strained through silk to separate the excess of mercury, and the globule of amalgam that remained was then decomposed by heating it in a clean iron pan, until the quicksilver was all expelled. The gold that remained weighed six grains, which is in the proportion of one hundred grains to one hundred pounds, or one bushel of the ore. These one hundred grains of gold, at $4\frac{1}{12}$ cents per grain, the price paid at the United States' Mint, amount to $4.08 for the one hundred pounds of ore. In a second trial, pieces of quartz were taken, which presented some points of metallic gold to the naked eye; they were not very numerous; and still, pieces were selected which were about as good in visible metallic gold as could be readily found. Two pounds of the powder of this ore, treated in precisely the same manner, yielded six grains of gold; this, being exactly three times as much as in the former trial, gave $12.25 to one hundred pounds, or one bushel of the ore. Perhaps it is not to be supposed that the mere accident of gold being visible would, of course, indicate so rich a result; and on the other hand, the mere fact that the gold is invisible, does not, of course, imply that the yield will be as low as, or lower, than that obtained in the first trial. The average of these two trials gives $8.16 for one hundred pounds, or one bushel. It is probable that this result is too high for a general average; even half this amount would be very rich, and a quarter of it would be very safe, supposing the expenses of working the mines to be no greater than they have been generally stated to be.

It is worthy of remark, that, by report, the earth around the Busby mine yields, generally, more or less of gold by washing; and I saw this statement repeatedly confirmed by experiments made under my own eye, upon the loose earth thrown out from the pits; it was understood to be that in which the quartz veins were imbedded in the ground, and had doubtless proceeded from the decomposition of the slaty rocks.

Indeed, through the whole of the gold region, I was assured that the loose materials of the surface are generally so far auriferous, that visible gold can, in many cases, perhaps generally, be extracted by simple washing. With a small iron pan, they wash the earth in a tub, or in some brook or branch of water, and many persons in the gold region have acquired the necessary tact. They call the operation panning, and the soil, gravel, &c. is said *to pan well* or *to pan poorly*, according to the result.

Moss' Mine.—This mine is three quarters of a mile from Busby's, and both mines are about fifty miles from Richmond and fifty three from Fredericksburg. Moss' mine is situated in decomposed slaty rock, the same which, in a greater or less degree, pervades the gold region. Here, in the portions nearest to the surface, the rock is completely destroyed, and is little else than a red clay;* lower down, it becomes somewhat firmer, and shews, distinctly, the lines of stratification and of the slaty structure. The inclination of the rock and of the included quartz veins is about forty five degrees; the direction by compass, is about N. by E. and S. by W. The diameter of the vein, which is at present wrought is, taking it at different places, sixteen, eighteen, twenty four, twenty seven and thirty inches, averaging about twenty four inches. The structure of the quartz vein is distinctly laminar; it divides easily into tabular portions, from half an inch, to four or five inches in thickness, and these pieces have cross divisions. Hence, the quartz is broken up with great ease, especially as there is no adherence of the quartz to the slate, and therefore blasting is not needed, nor are any instruments requisite except simple picks and crows, and other common tools. The mine is, at present, approached by a single inclined plane or covered way thirty one feet long in the slant, and twenty five feet deep in the perpendicular. There is another and a parallel shaft fifty feet deep, but now filled in the lower twenty feet, by earth washed in by recent rains. There is an adit connecting the two shafts which slant in the direction of the vein; the adit is seventy feet long, in the entire length, and the vein is exposed through this whole extent. I had full opportunity to examine the vein at the bottom of the mine, and it is impossible that one should be found more accessible or more easily wrought. With a view to a careful examination of the proportion of gold, I caused pieces of the vein to be knocked off in several places, at distances of twelve feet. From each of these pieces, portions were broken, and being carefully examined with a magnifier, no traces of gold could be any where perceived. They were then pounded and sifted, as in the case of the Busby mine; nine pounds were washed, and the gold was amalgamated and the amalgam decomposed by heat, precisely as in the former case.

From the nine pounds of ore, a button of gold was obtained weighing eleven grains, which is in the proportion of one hundred and twenty two grains for every one hundred pounds, or one bushel. This, at $4\frac{1}{12}$ cents for each grain of gold as before stated, gives $4 98 for one hundred pounds of the ore.

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* From which, by washing and subsidence, a good and very useful paint might probably be prepared—admitting of various shades by the application of heat—forming a strong color for coarse work, and an elegant one, if covered by copal varnish.

In another trial, three and a half pounds of the powdered ore in which no gold was visible, yielded six grains of gold, or one hundred and seventy one grains for one hundred pounds, equal in value to $6 98.

A third experiment on ore in which gold was not visible, produced five grains from two pounds, equal to two hundred and fifty grains from one hundred pounds, and worth $10 21 to one hundred pounds of ore. The average of the three trials upon the ore of Moss' mine is $7 39 to the one hundred pounds of ore; and the average of the five trials made in the two mines is $7 70. I am assured that when a mine yields one dollar to every one hundred pounds of the ore, (as the cost of working is stated to be about one third of this sum,) such a mine is regarded as profitable, and as justifying heavy expenditures in machinery and in operations of deep mining. At the Walton mine which I visited and examined, the average yield has been, as stated to me by the manager, $5 92* to the one hundred pounds of ore; and two skillful gentlemen obtained from ore of that mine between twelve and thirteen dollars to the one hundred pounds, being about the maximum obtained by me from the ore of the Busby mine.

I forbear to quote instances of a much larger product, stated to me as having been obtained from the Busby mine, because the result was procured by an officer of the mines, although I have no reason to question either his integrity or his skill. The average product at Fisher's or Hughes' mine, as stated to me at the mine by Mr. Fisher, is $3 15* for every one hundred pounds of the ore, and I infer from his statements of expenditure, that the cost is not over thirty to thirty five cents for every one hundred pounds. Comparisons cannot be made with accuracy between deposit mines and vein mines, because the expenses of working are so widely different. It may not, however, be useless to state, that at the Whitehall deposit mine, where twenty seven hands are employed, the work is profitably carried on, with twenty dollars of gold obtained at present, in a day, and it is said that two cents on a bushel would yield a good return. Being dependent entirely upon information obtained since I came into the gold region, as to the expense of working the mines, I give on this head merely the reports of others, but, I would suggest that the expense must, of course, increase as the mines are sunk deeper. It is true that experience in management and improvement in machinery, operations, and processes, will tend to diminish expense, and increase the product; but the ore may not continue equally rich, and on the other hand it may grow richer; this is, both ways, uncertain, and as no human science or skill can remove this ambiguity, it follows that mining enterprises cannot be relieved from this hazard. It is, however, wise to make estimates of expenses high, and of receipts reasonably low, that the chances of disappointment may be, as far as possible, provided against. Should the trials made by me, and under my direction prove, in the event, to be a fair representation of the average produce of the mines of Busby and Moss, (provided also, that the expenses have been correctly reported,) it follows of course, that the profits must be great. Prudence would suggest, however, that the estimate should be made at a lower rate than that which I have reported; if it were taken at one half of what was actually obtained, the yield would exceed that at Fisher's mine, which is understood to be a very profitable one; and if it were estimated even at one quarter, and the expenses are no greater than have been reported, the enterprise could still be profitably sustained, unless the interest of capital should cast the balance the other way.

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* And now mentioned by permission. I afterwards examined the Walton mine at another visit, and the report is annexed.

With respect to the sums paid for the mines, I am not called upon to speak, nor would it be proper that I should express any opinion. I would simply remark that, in my judgment, nothing could be more inauspicious to the mining interest and to the welfare of the country, than a spirit of speculation in these concerns. In an excited state of the public mind, it is rare that facts are correctly reported, or correctly viewed. The speculator, who buys merely that he may sell again, is, too frequently, ignorant of the facts, and reckless also of the consequence in regard to those who may succeed him in his obligations; flattering gains from sales of stock are reported from day to day; the property rapidly changes hands; the public mind being morbidly excited, is of course blinded, and at no distant period, accumulated ruin falls heavily upon the last in the train. This is exactly the opposite of that mental sobriety and moral rectitude which ought to govern men in all concerns, and especially in such transactions as these; it is not too much to say, that no man should either buy or sell a mining interest, unless he can, in honor and conscience, declare that he believes it can be profitably carried on.

So far as I have had opportunity to observe the gold mining region of Virginia, I am convinced, that in several places (and it is probable their number will be increased) the explorations may be prosecuted with advantage, while in other cases they will prove losing concerns. The small proprietors of land should not be encouraged to abandon their regular industry for gold hunting, and even when capitalists associate for these objects, (which is certainly the more proper course,) prudent men will be slow to pledge more than they can lose without embarrassment, certainly without ruin.

In recurring again to the mines of Busby and Moss, I have to remark that the land, (consisting as I am informed, of one hundred and eighty three acres—fifty three to Busby's, and one hundred and thirty to Moss', lying in tracts nearly contiguous,) is well wooded with valuable timber, and well watered for the purposes of mining or of agriculture. The soil is thin, like most of that in the gold region; but the physical features of the country are favorable to mining operations, the surface being formed in gentle swells; and good roads may be constructed at a moderate expense. At Moss' mine, about one thousand bushels of ore have been raised. It is due to the gentlemen charged with the management of these mines to say, that I have been most favorably impressed by their intelligence, zeal, and candor; and I with pleasure acknowledge my obligations to them for their uniform kindness, and judicious and useful co-operation during this investigation.

I am not willing to omit a deserved commendation to the master miners, both here, and at several other mines which I have visited; comparing them with persons of their profession with whom I was formerly conversant, in some of the most important mining districts of England, I am justified in saying that they appear deserving of confidence.

Mr. Forrest Shepherd, a gentleman who has had much acquaintance with the gold mines of Virginia, being present at the examination whose result is given above, and being requested by me to aid in the processes, states in a published letter, that at Moss' vein he saw the ore broken from the rock—that he counted every fragment, and broke portions in numerous places from these same fragments in order to obtain a fair average. This ore, he states, was pounded under his eye, and a part of it weighed by his own hands, and that the results given above, he believes to have been in all respects correct, both with regard to the veins and the gold obtained from them.

The Walton Mine, in Louisa County, forty miles S. W. of Fredericksburgh, and belonging to the Walton Mining Company.

The tract of land in which this mine is situated, contains one hundred and four acres. The surface is formed in fine swells and depressions, presenting hills, bounded by large curves, and vallies of similar shape. The soil is considered as good for agriculture; much better than the average of land in the gold region. There are several good springs of water, and several branches or rivulets quite sufficient for the washing of gold, but not sufficiently copious for driving powerful machinery. The land is clothed mainly with forest; the principal kinds of trees are oak of several varieties, pine, hickory, and maple: a good proportion of the trees are large, and well fitted for building or machinery, while the rest of the growth is good for fuel and other ordinary purposes. There are *passable* roads, communicating with the tract in every direction: some of them are good, and all are capable of being made so with moderate expense.

The geological structure is similar to that which pervades the gold region of Virginia generally, as far as I have seen it. In this region also slaty rocks form the basis of the country; their strata are highly inclined: they are not however placed on their edges, as in some parts of the gold country, nor dropped down to a position approaching the horizontal, as in other parts. At the place where the mine is opened, the strata form an angle of about thirty five degrees with the perpendicular, and their bearing, by compass, is considerably to the east of north. Several veins of quartz accompany the strata of slate, it is presumed quite through the territory. This is known to be the fact with the vein that is wrought, and it cannot be reasonably doubted that this is the fact also with all the others, whose *knobs*, evidently *in place*, and whose scattered ruins appear here and there above ground, although generally covered by forest, by soil, and by vegetable deposits. These veins are distinctly traced in the tract south, and it is believed, also, in that north; so that the land is fully and distinctly marked by the characteristic features of the gold region. There are also rich deposits and veins of gold in its immediate vicinity, as appears from the following facts, communicated to me by persons of good information, although not by the parties themselves.

Tinder's mine lies about two miles northeast from that of Walton. It has been explored, chiefly by surface diggings, and washings of the gravel, &c. The excavations of the surface are numerous and extensive, and within four or five years they have obtained forty thousand dollars, about seven thousand dollars of which was from a single depot. A tract belonging to Jenkins and others, lies between Walton's and Tinder's, and also immediately beyond the latter; from the Jenkins tract, by working in a careful and economical way, they obtain from two to three thousand dollars per annum, and Jenkins is in the habit of substituting a fall-working in the gold, for which he obtains one thousand dollars annually, as a compensation for his tobacco crop, which he relinquishes in favor of the gold. Within a few days, they have discovered on Jenkins' land, a vein of quartz, which is very rich in gold. A good observer, a master miner, informed me, that he saw in this vein of quartz, pieces of gold projecting from it, as large as the first joint of a finger. In consequence of this discovery, so much curiosity and cupidity have been excited, that they have been compelled to inundate the vein, until measures can be adopted for its adequate protection. At Boxley's, near Tinder's, they obtained, the first year, nine thousand dollars, and have probably accumulated twice that amount of gold in the whole. At Baker's, near Walton's, they gathered, with their own people, about five or six hundred dollars in one year. At William Goodwin's, a little south of the Walton Mine, they procured, with their own hands, about one thousand dollars, and at Childs', one mile and a half southwest, they got three hundred pennyweights. Thus it appears that there is much gold in the immediate neighborhood of the Walton Mine; there are also many places not named above, and not far off, where gold has been obtained by washing; and measures, as I am informed, are about being taken, to open some other places in this region, more effectually.

These facts are of great value, as indicating that the tract now under consideration must also be auriferous, and were its real character in this respect unknown, we could scarcely doubt that it must resemble its neighbors. But we are not left to conjecture. Four years have now elapsed since diggings and washings for surface gold were commenced here upon three branches, (small streams,) and the precious metal, being discovered in all these situations, as well as in various other places upon the land, the explorations were, for some time prosecuted with considerable energy, as may be inferred from the diggings in many places, and more especially from the great piles of gravel now lying near the principal branch. They remain still, to a great extent unwashed, and it is believed they would pay well, if subjected throughout, as portions of them have already been, to the rocker and to amalgamation. This will probably be done at some future period of more leisure and convenience. That it has not been already done, must doubtless be attributed to the discovery very soon after the surface gold had been found, of the rich vein of auriferous quartz, which, with its contents, will now claim our attention.

This vein has the same bearing and inclination as those already described in connection with the slaty rocks, between which it lies. The vein is over one foot in thickness. The quartz is, in general, firm and compact; occasionally it is porous and interspersed with iron pyrites and a dark iron ore, probably proceeding from their decomposition. The slaty rock is much decomposed—or as it is termed by the miners—*it is rotten:* it is therefore, at least in the upper strata, easily broken or cut by tools; it, as well as the quartz of the vein, is much stained by iron, and both are, to a degree, mixed in the heaps of ore. In the more profound depths of the mines, it is to be expected that the rocks will be found firm, and that they will require, (as in many mines of the gold region they now do,) blasting by gun-powder. As in penetrating into the earth we recede from the influence of the atmosphere and of the weather, we are to expect that both the vein of quartz and its rocky walls will oppose more resistance to the miner than they do near the surface. The vein of quartz which has been worked in this mine, has been penetrated by two shafts, one seventy and one forty feet deep: they are connected by two parallel adits—one of which is at the depth of forty feet and the other of seventy; the shafts are one hundred and five feet apart, but the adits are one hundred and ten feet long. The flow of water into these excavations is so considerable, that a feeble horse power, which is at present applied by buckets connected with the horizontally revolving machine, called a whim, is quite insufficient to keep the shafts and adits clear. The ore is therefore not at this time raised from the mine, nor is it now possible to descend into the adits, without several days of previous labor in raising the water.

As regards a satisfactory examination of the true nature of the mine and of the ore which it yields, this is, however, of no importance; for there is already above ground a very large quantity of ore obtained both from the shafts and adits, giving full information of the productiveness of the vein and of the quality of the ore. From the regularity, the thickness, and the great extent of the vein, there can be no reasonable doubt that it will continue for a long time to afford an abundant produce, nor can any reason be assigned why the richness of the ore should be diminished. This is indeed a point upon which human sagacity cannot give us absolute assurance, and it must always be remembered that mining operations invariably involve a degree of uncertainty, because we cannot see what is below, until our operations have penetrated to those dark recesses and brought to light their hidden treasures. A favorable presumption is, however, as well sustained in this case as it can be in any, and we therefore proceed to the very important and responsible duty of ascertaining the proportion of gold, which the ore hitherto raised will yield. For this purpose four trials were made. 1. A trial was made upon ore, believed to be as poor in gold as any average which the mine has hitherto yielded. 2. It was made upon ore supposed fairly to represent the average richness of that hitherto raised. 3. It was made upon ore taken at random, without any reference to its being either rich or poor. 4. And finally, upon selected pieces, showing gold to the eye, and supposed to be rich.

1. The first trial was made upon a portion of ore, which, last year, was prepared on a considerable scale for an average trial. It was deemed proper to re-examine that result, as the conclusion drawn from it was highly important, and had deservedly produced a decisive impression upon the opinion entertained of the value of the mine. On that occasion, ninety-two bushels of the ore, taken promiscuously, were roasted, ground, washed and amalgamated. More than five hundred dollars were obtained as the result, and the average yield was $5 92 for one bushel, or one hundred pounds of ore. These facts are given on the statement of the individuals concerned in the experiment, one of whom is still at the mine. Several bushels of the prepared ore then used are also still there. From this residuum six pounds were taken—but there was this important difference in the trial—all the visible gold had been carefully picked out during the pounding, sifting, and other preliminary operations, and the material now used contained apparently no gold, and looked

indeed like a mere mass of Spanish brown, prepared for painting; the color was darker than that of the pulverized ore generally, because it had been operated upon by fire. The six pounds of this material were then washed—the gold, now become visible, was amalgamated, and when the mercury was expelled by heat, there remained five grains of gold, being in the proportion of eighty-three grains to one hundred pounds, or one bushel of ore, and having, at $4\frac{1}{12}$ cents a grain, the mint price, the value of $3 39 for one hundred pounds.

Considering that in the trial made in the large experiment before cited, all the gold was in the ore, and that in this trial all that was visible had been picked out—considering also that in this smaller trial the proportionate waste of gold in washing was greater than in the larger, it would appear that the conclusion stated, from the examination of the ninety-two bushels, was sufficiently sustained. Under all the circumstances which have been stated, the trial now made upon the six pounds of the residuum of the great experiment, may be fairly regarded as standing for the poorer sort of ore; this will more fully appear by comparison with the other trials that are now to be stated.

2. In addition to the large mass of ore more or less mixed with the slate, and now lying at the mouths of the shafts, there is in the ore-house, a pile, supposed to contain from twelve to fourteen hundred bushels, upon portions of which the remaining trials were made. The condition of this ore is as follows: The firm masses of quartz, from the size of a hen's egg to that of a man's fist or of a human head, are mixed with smaller fragments, and with the mere ruins both of the quartz and the slate, more or less pulverized, and much of it is in the condition of powder, or of the fineness of common dirt or soil. This rude heap is, to the eye, quite uninviting; it looks like a pile of yellow ochre, mixed with dirty quartz stones, and were an uninstructed observer to be assured that it contains a great treasure, even at the lowest estimate, many thousand dollars, or possibly many thousand guineas, he would consider the speaker as trifling with his understanding. Still, although the heap exhibits to the eye, no appearance of any metal whatever, except iron rust, it is, without doubt, as will now appear, a treasure of great value.

By my direction, a hole was dug deep into the pile, and the materials being taken up with a shovel, promiscuously, just as they came, a sufficient quantity of both large and small was pulverized and sifted. Of this, six pounds were taken and washed in the usual way; the gold which now appeared in decisive quantity, where none was before visible, being amalgamated, and the amalgam strained and decomposed by fire, amounted to twelve grains for the six pounds of ore; this, being in the proportion of two hundred grains to one hundred pounds, equals $8 16 for that amount of ore. This trial would appear to be as fair a one for the ore-heap as could well be made with the same weight of the materials.

It may be important to observe, that in a visit to this mine two weeks before, although not then *authorized* to examine it *responsibly*, I was desired by Dr. Benjamin Coleman, agent for the Richmond Mining Company, and at that time with me, to pay some attention to this mine, that I might be the better able to judge of the mines in Goochland county, which I was soon to visit, and of which an account is contained in the preceding pages. I did, accordingly, then examine the condition of the ore of the Walton Mine, so far as to cause portions to be pulverized and washed from various parts, inside and outside of this ore-heap, and there was, in every instance, a yield of gold so striking to the eye, that had the amalgamation and extraction been finished in the way above described, I cannot doubt that the result would have been substantially the same with that now obtained. These facts, taken in connexion, leave then no doubt as to the average richness of this pile of ore, and of course of the vein from which it is derived.

3. The third trial was made upon pieces of solid quartz, taken at random from the heap of ore; no gold was observed upon them, but on being pulverized and washed, the powder showed gold richly, for when the usual process by amalgamation and evaporation was finished, six pounds of the material yielded thirty grains of gold, answering to five hundred grains, and equivalent to $20 41 for one hundred pounds, or one bushel.

4. The fourth and last trial was made upon pieces of the quartz, selected on account of their showing gold to the naked eye: no pieces were admitted which did not exhibit one point or more of gold; few showed more than two points, and generally they were not larger than the head of a common pin. Of this lot of ore when pulverized, four pounds were taken and washed and amalgamated; the product of gold was one hundred and thirty-one grains, in the ratio of thirteen hundred and ten grains for one hundred pounds, and equivalent in value to $133 73.

The product of the four trials was—

1.	For one hundred pounds, ...	$3 39
2.	" " "	8 16
3.	" " "	20 41
4.	" " "	133 73
		$165 69

Division by four gives the average $41 42 for one hundred pounds.

This result, startling as it is from its magnitude, is, I am certain, below the truth, because some of the gold was lost in the washings. That there was no imposition is equally certain. I went with the master miners to the ore-house the moment of my arrival: the processes were, from beginning to end, conducted under my constant inspection and that of two confidential companions, and during this time the ore-house, including every thing relating to the processes, was double-locked whenever I left it, and the keys were always about my person until we resumed our work, nor did I ever, at any moment, leave the premises while they were open.

It may be added also, that the character of the master miners places them above all suspicion, and neither they nor any one concerned in assisting in the labor, had the smallest interest in the result.

I can truly say, that I could have wished the product had been less rather than more, for I greatly fear the effect on the community of the golden dreams which it may produce, and therefore repeat the cautions already thrown out. I would suggest, that an average much lower than that actually obtained, should be the one adopted, to be acted upon. It would certainly be wise to throw the fourth trial aside, as one which, although it may be sometimes exceeded at this mine, (which I am informed has been the fact,) may not often be attained, and never except upon selected or accidental specimens. The three first trials would appear to give results such as may often be looked for; their average is $10 32 to the one hundred pounds of ore, but it would probably be unwise to form any important arrangements even upon this result. It is, I suppose, certain, that one far below this, even as low as that obtained in the first trial, would form a very safe basis of proceeding, granting that speculation has not enormously enhanced the price of the stock. As to this, as I can form no calculations whatever, I wish distinctly to disclaim any responsibility for its results. My duty is performed, in all the cases in which I have been charged with inquiries concerning the gold mines of Virginia, when I have correctly and faithfully reported their actual condition, and the produce in gold of those portions of the ore which I have examined. That the Walton Gold Mine and many others in Virginia may be profitably wrought, admits of no doubt—provided, that in all cases, good judgment, sound economy, competent skill, adequate machinery, and strict fidelity, combine their salutary influence; otherwise, the result may be calamitous, and the discovery of the precious metal in Virginia may prove a curse, instead of a blessing. There can, however, be no reason for believing that these interests will be abandoned. They will be pursued with sobriety, and in many instances with success. The enterprises are still in their infancy; experience will, in this case, as in other cases, prove the best instructress; in all probability, many rich gold deposits and gold veins remain to be discovered both in Virginia and in other States, and our country may confidently expect from its own territory, here and elsewhere, sufficient supplies of gold for its coinage, for the demands of the arts, of ornament, and of use, and not improbably for exportation.

Prof. Rogers, of the University of Virginia, inspected this mine in April, 1836, in company with Mr. Forrest Shepherd: they give the following results.

1. In the lower adit leading from the main shaft, which was examined throughout, the auriferous vein of quartz rock presented a very uniform thickness, varying from a little more to a little less than twelve inches in width.

2. The talcose rock, underlying the vein, is also auriferous to a distance of six inches, and sometimes more, from the quartz.

Prof. Rogers was strongly impressed with the continued yield of gold obtained from the quartz, by pulverizing and washing, and by the uniform dissemination of the gold throughout the quartz, and the lower enclosing rock. From forty seven pounds of the ore 6.5 pennyweights of gold were obtained by amalgamation and evaporation of the quicksilver, giving nearly 14 pennyweights to the one hundred pounds; a result which coincides remarkably with some of those obtained by me.

Mr. Shepherd remarks, that by diligent search, no gold of any importance has been found either eastward or westward of Walton's tract.

The Culpeper Mine, belonging to the Culpeper Mining Company.

The mine is situated eighteen miles west of Fredericksburgh, upon the river Rapidan, a few miles above its confluence with the Rappahannock. The tract is stated to contain five hundred and twenty four acres, of which about two hundred are in forest; a fair proportion of the woodland is covered by pine and oak trees, of large size, and excellent quality; the oak affords timber of the best kind for machinery, and the pine, (chiefly of the red heart kind—most of it being heart,) is admirably fitted for the construction of the buildings. This species of pine is understood to be confined to a small portion of country. The rest of the forest-growth is fitted for fuel and other common purposes.

The soil of the tract, like that prevailing, generally, through the gold region of Virginia, is thin.

The surface is varied; the portion nearest to the great public road, leading to Culpeper Court House, is nearly level: that upon and near to the river is formed in fine undulations, with hills which rise one hundred and thirty feet above the Rapidan, and afford great facilities for mining. These hills are similar to others on the opposite side of the river; and they, with the intervening vallies—the woodlands—the cultivated fields and the stream, form striking features in a varied and beautiful landscape. While the river Rapidan affords most abundant hydraulic power, for mills of every description, and washes the entire boundary line of the tract on one side—a considerable rivulet or branch called Patrick's Run, passes through the land, furnishing every facility for washing the ore, and even considerable resource for machinery.

The buildings, of every description, are of a better construction than are generally found at the gold mines; with scarcely an exception, they are framed substantially, and clap-boarded; there are houses for the miners and laborers, besides inferior cabins: there is a good blacksmith's, shop and store-room adjoining; an ore-house properly secured—a magazine for powder and other valuable things, situated on a high point, at once conspicuous and completely detached, and in all the arrangements, attention has evidently been paid to the morals and decent manners, as well as to the comfort of the people. There are two ore-yards faced with substantial stone walls, and properly levelled: they are, of course, contiguous to the principal adits or mouths of the mine.

The hydraulic power, already mentioned, will soon be turned to great account, by the various constructions now in great forwardness. The entire river Rapidan, here about three hundred feet wide and three feet deep—is raised by a dam, now nearly finished, near the uppermost point of the tract of the Company. The dam is two hundred and twenty five feet long, besides the abutments, which are one hundred and sixty feet more, making four hundred and twelve feet. The height of the dam is in front nine feet—rising six feet above the water below; the water above the dam is eight feet deep, and below it is three feet.

The object of the dam is to turn the water into a canal which runs along the left bank of the river, for the distance of five thousand four hundred feet—over one mile. This canal, which is already to a great extent excavated, is from eighteen to twenty feet wide at top, and nine feet at bottom, and fitted for a depth of water of seven feet.

The river will be led into it, through a very strong gate-way, supported by a powerful frame-work.

The amount of water-power secured by this canal, is so great, that several mills, in addition to those now in construction, might be driven by it. A saw-mill for the purposes of the mine, is in the course of construction, above two-thirds of the way down the canal; it will be supplied by a lateral cut. The building is forty five feet by fourteen; it will contain one saw, which will cut one thousand five hundred feet of inch plank in a day.

The stamping and amalgamating mills, for which mainly the canal is excavated, are to be contained in a building sixty four feet by thirty, of very strong timber, thoroughly framed. It has a basement story of twelve feet high, substantially built of stone. The water wheel is sixteen feet by nine, and is undershot. It will carry twenty heavy stamps, for crushing the ore, and the number may be doubled. There is room and power enough for Chilian, Tyrolese and Araster mills, if the latter are desired; but, it is intended to annex the simple amalgamating bowls of Mr. Hitz, the skillful machinist, whose work in this mill does him great credit, both for its strength and ingenuity, and it is said that his amalgamating bowls are very effectual, while they are comparatively cheap and simple.

The mining operations are considerably advanced, and are conducted by Mr. Hitz, with regularity and skill. The elevation of the ground into hills, rising, as already stated, one hundred and thirty feet above the river, presents great advantages for drainage, and for working the mines in other respects. There are various shafts formerly excavated by Hempstead and others—most of which, being neglected, have fallen in, or are in a state of dilapidation, so that they require no particular notice.

A capacious shaft is now in the course of being excavated, in the highest part of the hill nearest to the river. Its dimensions are ten feet by four, and its depth is, at present, fifty seven feet: it is sinking, at the rate of two feet a day, and it will continue to descend, until it meets the adits from the opposite sides of the hill entering at its base. The shaft will probably be one hundred and twenty feet deep. At the depth of forty feet, there is a tunnel, branching off on both sides, from the shaft; it is in the whole thirty five feet long, pursuing the course of the vein, which is from eight inches to twenty four, and even to thirty inches wide: the tunnel is timbered, as far as is necessary, and is six feet by two and a half in the clear. The shaft also is thoroughly timbered and planked, and furnished with a good ladder and a strong windlass, rope, and buckets, so as to afford all necessary security. The passage-way, in which the ladder is suspended, is partitioned off from the rest of the shaft. At the bottom of the shaft, the vein is from six to fifteen inches wide. In each of the two hills in which the mining operations are carried on, there are two adits. Beginning with the hill nearest to the river—at or near its base, and about twenty or twenty five feet above the level of the river, an adit has been opened into the hill, with the intention of communicating with the shaft already described. This adit is well timbered and planked, so as to be perfectly secure: the planks are two inches thick and the dimensions in the clear are six feet by two and a half; its length at present is one hundred and twenty three feet, and it is increasing at the rate of three feet per day—varying however with the hardness of the rock. There are two cross-cuts in the adit intended for exploration, and they serve also as a refuge for the miners, from the fragments thrown off in blasting: their length is fourteen feet for the one, and twenty eight for the other. The adit is floored with timber and plank, and there is a free passage under it of six inches deep or more, for the discharge of water and for ventilation: this purpose it answers extremely well—the current of air being so strong beneath the floor as to blow out a lighted candle, when placed at its mouth. This mode of ventilation is so effectual, that an adit can (in the opinion of Mr. Hitz,) be driven one thousand feet into a hill, without sinking a shaft to meet the level. The adit, just described, is named No. 1, and, as already stated, will be driven in to meet the shaft.

The adit opposite to this, on the other side of the hill, is named No. 2, and is, in all respects, similar to No. 1—except that there is a deviation of the vein, nearly one hundred feet from the mouth of the adit, which causes an abrupt offset of seven feet to the left, where the vein is recovered. The entire length of this adit is, at present, one hundred and seventeen feet, and when finished, it will, like No. 1, strike the shaft common to the two adits, forming one continued communication, which will completely perforate the hill, and afford a passage through, from side to side. The vein in this adit is two and a half feet wide, measured in two places. In adit No. 1, the vein was less perfect, being divided into strings or ramifications. From No. 1, about four hundred bushels of ore had been taken. The ore at the shaft and at the other adits, was not estimated, but its quantity was very considerable. Adit No. 3, is carried into Hempstead's hill: its mouth is immediately opposite to that of adit No. 2, and it is separated from it only by a small branch of water: it is in fact a continuation of the two adits 1 and 2. No. 3 is, in form and cross dimensions, like the others; it is one hundred and fourteen feet long; it is very strongly timbered with oak posts and two inch plank. Adit No. 4, is on the southeast side of this hill, and its course is at right angles to No. 3: it enters at a lower level, probably twenty or twenty five below, and, like No. 3, is intended to strike Hempstead's old shaft on the top of this hill, and near its centre, which shaft may be opened again.

In addition to the adits already described, another has been opened, a little to the northwest of No. 3: it is called the dust-vein, as the ore is obtained from it in a powdered state, at least in part. This adit has been, as yet, driven only a few feet into the hill—but it discloses a vein about six feet wide, which is found to be rich in gold. This appears not to be the entire breadth of the vein: there is an additional mass of quartz in place, by the side of this adit, and not yet excavated, which is four feet wide—making a vein in the whole, (with the addition of the dust vein of which it appears to be a part,) ten feet wide. This vein is doubtless a distinct one from that in which adits No. 1 and 2 are excavated. Of these veins we are sure, and probably others will be hereafter disclosed. There can be no reasonable doubt, that the knobs and other fixed masses of quartz observed in numerous places, here and there, on the tract, are parts of *veins in place*, and that the loose fragments of quartz which are scattered in profusion, upon various parts of the ground, are attributable to a similar origin.

The main vein, hitherto worked in this tract, appears, in some places, prone to divide into strings: sometimes several, perhaps not longer than a finger, proceed parallel, or nearly so, being separated only by portions of the slaty rock: their separation appears, in general, to be only temporary; for the greater part, they again converge, and unite in a main vein, and the gold is observed to be more abundant in these strings than in larger veins. There is much iron accompanying the ore of gold. It imparts a red color, more or less intense, and the pulverized quartz is almost always red or brown. There is here an iron ore regarded by some as a hydrated oxide. It appears to have proceeded from the decomposition of iron pyrites, which, in many places, are still found fresh and brilliant; in other instances, splitting, rusting, and undergoing decomposition, the result of which is, that a portion of this mineral passes off in the form of sulphate of iron or copperas, which water easily dissolves, while a large portion remains in the form of a vesicular and corroded dark brown or red oxide. So far as this ferruginous matter contains gold, it is doubtless derived from the iron pyrites, which appears to be more or less auriferous, and when it is decomposed, the gold, being insoluble either in the water or in the sulphuric acid which is generated, remains mixed with the oxide of iron, that constitutes the residuum. There is, in some cases, a gradual passage from the brilliant yellow pyrites into this brown or black iron ore.

The strata found in this tract, are varieties of slate and of various other rocks, frequently associated with this primary family. They are remarkable for being placed in a position, nearly or quite perpendicular: the strata stand on edge, or if inclined, they form but a small angle with a vertical line, and consequently, nearly or quite, a right angle with the horizon.

This position of the rocks is very advantageous to the working of the mines, because, the veins of auriferous quartz, being laid between the layers and strata of the rock, are therefore, like it, nearly or quite perpendicular—consequently, the working of the vein creates a vertical adit, in which the miners can stand erect, and when it is wrought quite to the surface of the ground, the opening will be a perpendicular fissure, of easy access.

The direction of the strata by compass, here conforms to the general geological structure of the gold region, and of the continent, being about N. by E. and S. by W.

That the gold region of Virginia, although of very unequal value, is, on the whole, rich in the precious metal, admits of no doubt. It appears also, from satisfactory evidence, that much gold has been already taken, from this vicinity, on both sides of the Rapidan river. Gold is obtained in probably all the branches. Hempstead gathered from the hill and chiefly from the shaft which bears his name, in 1831 and '32, about $4,000, and nearly $3,000 of this was obtained in sixty days: he was aided by only two men, two boys, and a two-ox team, and his excavations were not very considerable. Large sums have been taken from tracts on the opposite side of the river. Ten branches that were examined on this bank, all afforded gold; and out of about one hundred washings, almost all were successful. On Grimes' land, two or three miles from the river, 12 or $15,000 were obtained; and on Greenwood, not less than $40,000. Judge Coulter, immediately opposite, has taken up 10 or $12,000, and is obtaining more. The greater part of this gold was found by washing alluvial matters. On Greenwood there was a rich yield from a vein, and there are auriferous veins on all the above named tracts.

But the question of deepest interest is, what proportion of gold may be reasonably expected from this mine—from its auriferous quartz and their contents, and from the rocks themselves as far as they bear gold? Mining operations are always, to a degree, uncertain in their results. No knowledge or sagacity can enable us to decide, with absolute certainty, on the proportion of the desired treasure, which lies below; it may diminish—it may increase—it may vanish. In a country whose geological structure is uniform like the region before us—where the veins appear to be subject to little irregularity and to constitute an important and probably an original feature of the rocks, we can discern no reason why their metallic contents, and, in the present instance, why the proportion of the precious metal should diminish. That it is, however, very unequally distributed in the veins is manifest, and therefore a trial made in a single place might afford a result either too discouraging, or too flattering. With a view of avoiding, as far as possible, this source of error, portions of the ore were taken from various places; in the veins at the bottom of the shaft, and at the end of the adits; and also from the heaps that had been thrown out of the mine. From fourteen or fifteen localities, including a great number of specimens and ore of all varieties, portions were knocked from each piece, crushed, ground and sifted: they were then washed in pans in the usual way: gold, in every instance, became visible to the naked eye in consequence of the washing, although little or none could be discerned in the fragments, even with the aid of a good magnifier. The gold, of all the washings, was then brought together and amalgamated with mercury that had been previously distilled; the amalgam was freed from redundant mercury, by straining it in leather; and being then decomposed by heat, so as to expel all the quicksilver, the remaining gold was carefully weighed.

Eleven pounds of the mixed ores, thus treated, gave a little over four grains of gold, which is in the proportion of thirty-seven grains to one hundred pounds, or one bushel of the ore—equalling in value, at the mint price of 4$\frac{1}{12}$ cents for one grain—*one dollar and fifty cents.*

Another trial, upon a small number of pieces, gave one grain of gold from five pounds of the mixed ores: this is in the proportion of 82 cents for one hundred pounds of ore.

In still another experiment, ore was taken from a vein considered as decidedly rich, but shewing no visible gold. Two pounds of this ore gave two grains of gold, being the proportion of one grain to one pound—or one hundred grains to one hundred pounds of ore, and in value equal to $4 08.

The average of the two first and lowest trials, gives $1 16 to the one hundred pounds of ore: the average of the three trials is $2 13 to the one hundred pounds of ore.

The average of the two most favorable trials is $2 79 to the hundred pounds. I ought not to omit to state, that from a small quantity, perhaps two ounces of very unpromising fragments, a very rich washing of gold was obtained in my presence, far surpassing the results which I have above reported.

It has been already stated, that from information received from many quarters, respecting the expense of working the mines, it would appear that, in general, it does not exceed 30 to 35 cents on one hundred pounds of ore, and consequently the average trial on the large number of pieces presents a favorable result as regards the prospects of this mine. This is probably the trial which is most to be relied upon, and it was certainly a severe experiment for the mine. It may be regarded as affording as fair an approximation to the real productiveness of the mine as can, at present, be obtained; for the ores were taken from every place in the hills where any diggings had been made, and no allowance was admitted for waste in washing. That this waste was of some moment, appears from the fact, that on washing again the matter which had flowed from the pans, a small portion of gold was, in every instance, obtained, even when the washings were, again and again, repeated, on the successive overflows of the pans.

This fact, always observable in a greater or less degree, in the washing of the gold, deserves to be particularly insisted on here. It is certain that an important proportion of the very fine particles of gold is usually lost in the washings. Those who are expert in this manipulation find, that a fourth, and even a fifth or a sixth washing will yield a valuable portion of fine gold.

This occurs more generally in the pyritical ores in which the gold is imbedded in excessively fine particles. This mass when reduced to fine powder, gives a residuum of oxidized iron, (commonly called black sand,) equal almost, in weight, to the fine gold, the latter being malleable or flattened, while the former, being brittle, remains rounded or angular; in washing this mixture in the pan, the gold generally remains on the upper side of the mass, and is therefore more liable to be washed off by the slightest ripple of the water. On the other hand, when the gold is imbedded in quartz ores, especially those with fine fractures, called in Virginia sugar ore—more properly granular quartz,* the gold being of a similar form, is more quickly disengaged, and appears in larger grains. On the contrary, the ferruginous grains or iron sand are so fine as to be scarcely visible, and are invariably found at the bottom of the mass or residuum, and therefore, as well as on account of their greater weight, are much less liable to be carried off by the ripple of the waters. In the purer quartz ores, ordinary care in the use of the pan will recover, at the first washing, a much greater proportion of the gold than in the other case, where repeated and careful repetition of the washings will never fail to give an additional yield. Hence arises the necessity of a different mode of operation upon the two kinds of ores; a view which a regular chemical essay would doubtless sustain.

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* See the preceding account of the Moss and Busby mine.

There is, therefore, no doubt that the result stated above is below the truth, as regards the quantity of gold; and still it would be better to calculate upon returns rather less than more, in relation to the operations in the large way. In estimating the actual results of the mining operations in the gold region, those concerned will of course take into view the interest of capital laid out in the purchase of the gold lands. On this point, I am not called upon to express an opinion.

Were it possible, however, it would be very desirable to extinguish the spirit of speculation which is producing a dangerous excitement in the public mind, equally hostile to the true interests of the mining region, and of the country, and dangerous to individuals. It would be very desirable that the mines should be purchased only by those who intend to explore them, and not by those who buy merely that they may sell again, perhaps at a very short period, and for a price suddenly advanced, not in consequence of actual returns from the mines, or of a reasonable prospect that they will soon be realized, but because the community is in a state of unnatural excitement.

Virginia has, in her territories, great mineral treasures; but they are to be obtained only by sober industry and skillful application of knowledge and capital; nor would all her hidden treasures of gold, if brought to light, form any adequate compensation for the abandonment of her agriculture and the substitution of a spirit of wild speculation.

The comparatively deep explorations of the Culpeper mines have probably developed, in a good degree, their real character, and there is therefore not so much danger of error as in those cases where the mining has been less thorough and less extensive.

This mine possesses also important advantages, in consequence of its great water power, and the favorable form of the ground, which will enable it to obtain a profitable return, not to be realized, in an equal degree, by a richer mine without similar advantages. It is not believed that this mine will need the application of steam power, certainly not for a long time, because the water can be drawn from the excavations either by gravity, or by machinery connected with the hydraulic power of the mills; and it is expected, even, that its superfluous force, that which is beyond what its own exigencies may require, will in the course of some time, be applied to aid the operation of the mines in the vicinity, not possessing hydraulic power.

In my investigations in the case of the Culpeper mine, and of other mines in the gold region of Virginia, I have received the able and zealous assistance of Mr. Forrest Shepherd, whose minute acquaintance with the topography and peculiarities of this portion of the country, and whose knowledge of the sciences, which have a bearing on this subject, qualify him for extensive usefulness in this department of service, and justly entitle him to confidence.

Gold Districts of the Virginia and New England Mining Company, in Louisa County.

This tract, recently belonging to Mr. William Walton, contains 193¼ acres, and joins to the rich gold tract described above, and now the property of the Virginia Exploring and Mining Company, except that a narrow tract, called the Triple Fork, intervenes, which tract belongs to the Goochland Mining Company. This tract, which is about two hundred yards wide, does not differ materially from that of the Virginia Exploring and Mining Company. Like that land, this contains gold, but it has been only imperfectly explored. Two years ago, a shallow excavation was made, and by the use of a rocker, a few pennyweights were obtained each week, amounting in ten weeks to 680 pennyweights in the whole, and it is expected that the work will be resumed.

This tract appears to be a continuation of the same gold region, its geological structure being the same with that of the rich Walton territory above named. Slaty rocks form the common basis of the whole territory, and upon them lies gravel, then clay, and then soil and forest.

This portion of land is intersected by six veins of quartz, three of which appear very distinctly in the public road, one more obscurely, and one of them is believed to be the identical vein* which, near Mr. Walton's house, is very productive of gold;—no reason appears why it should not be equally productive here, but as it has not been opened, this cannot now be positively known, and it must be decided by future exploration.

No thorough investigation has, as yet, been in any way made upon the tract; mining has not been even begun, and only a few imperfect trials have been instituted for surface gold, by washing the gravel and other loose materials. As far as these trials have been made, they decidedly favor the opinion expressed above, as to the nature of the country. Several persons of good character stated to me, that they, by washing, had obtained gold upon this tract; and gold was procured on the lands, under my own eye, by the usual process of digging down to the gravel and washing; Mr. Forrest Shepherd, also, both now and formerly, procured the same result. These facts, taken in connection with the structure of the country, and with the additional fact, that in the immediate vicinity there is a rich gold mine, leave no doubt that this tract belongs to the same gold formation. The important question, whether this land contains gold enough to justify working it by superficial or by mining processes, can be decided only by actual trials. There appears sufficient encouragement to render it proper to expend a reasonable sum in digging into and washing the gravel in numerous places, and in opening the principal quartz veins, here and there, for a few feet or yards in depth.*

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* On the authority of the county surveyor, Mr. Richardson.

Fauquier and Culpeper Counties.

The extensive tracts about to be mentioned, in the counties of Fauquier and Culpeper, amount, collectively, to three thousand or four thousand acres, but in them no considerable explorations for gold have been made. There are no shafts or adits to afford facilities for observation, nor have even the alluvial deposits been, to any considerable extent, examined by the simple operations of the washing pan. It was not in my power to make any attempts of this nature: there were no means at hand for such purposes, nor was it in any way possible for me, at the time, to discharge the duties of the practical miner; I did, however, all that the circumstances of the case admitted.

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* I have recently seen a letter, dated Nov. 21, 1836, from a master miner on the spot, a man of skill and integrity, with whom I am personally acquainted, stating, that a very rich vein has been discovered upon the land adjoining this tract upon the south, and it is believed that the vein runs through the ground now under consideration. A new vein has also been discovered in the Walton territory, to the west of the main vein; it promises to be good. In support of the opinion that this is probably a valuable gold tract, may be cited all the facts detailed above respecting the Walton Mine, and also those relating to the numerous gold mines and deposits lying in this vicinity in several directions, and at a very moderate distance; these facts it is unnecessary to recapitulate, and their bearing upon the present case is too obvious to require an explanation. It would, indeed, be most extraordinary if this tract, being surrounded by gold, should itself afford none of the precious metal.

I visited and explored the tracts in question, on both sides of the river, after having also examined, to a sufficient extent, the adjacent gold mining estates.

My visit to these grounds was reserved for the last, among a series of examinations of gold mines, and of tracts of gold-producing lands, which occupied me during several weeks, and which carried me through a continued line in the gold region, extending from the Union mine, in Fauquier County, to the mines of Buckingham—about eighty miles.

During these investigations, in which I have been very ably assisted by persons having exact local knowledge, and much acquaintance with the peculiar indications of gold mines in the region in question, I myself acquired the requisite familiarity with the physical features of the country, and a degree of skill in judging of the indications that are important to be observed. My last occupation antecedent to visiting these lands, was in the grounds of the Culpeper Mining Company, on the Rapidan river, which forms the boundary, on one side, of the narrow neck of land included between the river just named and the Rappahannock: this tract does not, at this place, exceed three miles in breadth. The Culpeper mine, as appears from the facts stated above, is one of decided value.

For the same reason that I mentioned the Walton mine and other gold tracts in its immediate vicinity, in connexion with the notice of the lands of the Virginia and New England Company in Louisa County, I name the Culpeper mine here, and also the other mines in the same region,* because their vicinity to this tract makes them, in some measure, a key to the true nature of the territory. I allude to the gold mines that are intermediate between the Culpeper and the present territory, namely, the Rossin, the Cromarty, and the Millbank, all of which, we are assured, are valuable gold grounds, and they form an uninterrupted line of communication to these lands. I visited the Millbank mine, and although I had no opportunities of investigation while there, the favorable opinion entertained by the proprietors of the value of this mine, is sufficiently indicated by the extensive adit which they are now cutting there, preparatory to other still more important operations. The Millbank mine completes the series, beginning at the Culpeper and proceeding N. E. until we strike these grounds, which are immediately contiguous. It gives additional strength to this view, that the estates opposite to the Culpeper mine, and lying on the other side of the river Rapidan, are rich in gold.

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* I am informed by Mr. James Williams, of Fredericksburg, that several places of richer ores have more recently been discovered at the Culpeper Mine.

F. Shepherd.

There can be no doubt, therefore, as to the general nature of this region, and it remains only to inquire whether the peculiar features indicating gold are continued through the territory on both sides of the Rappahannock. To this question the answer is decidedly in the affirmative.

The ranges and strata, like those of the gold-bearing rocks, with their quartz veins, the same that, with slight variations of appearance, are seen through the gold region, are here conspicuous, passing under the river Rappahannock, and appearing in the lands on both its banks. The same slaty rocks that characterize the gold region elsewhere in Virginia, are seen here; as in many other places, they are highly inclined, and in general, the quartz veins have the same inclination as the strata and layers of rock, and lie between them. On the northeast side of the river, in the Mount Ephraim estate, the veins of quartz are large; their ruins are numerous, and lie in massy piles on the surface, presenting, sometimes, over a considerable surface of quartz, a delicate frosting of minute crystals of quartz, and at other times the crystals are distinct, having perfect forms. In the extensive tract on the southeast side of the river, the veins of quartz are numerous; they are not so large as on the other side, but they are better defined, and often assume a promising appearance, being accompanied by that bright or deep red earth, so commonly seen through the gold regions, and which has probably proceeded from the decomposition of pyrites, so frequent a companion of gold in Virginia.

In answer to the inquiry whether gold has been actually found upon any portion of these tracts, the facts are not numerous, but as far as they go they are satisfactory. We are credibly informed, that gold has been repeatedly found in both territories by washing; my witness is one who himself obtained the gold on the southeast side of the river, and he had the statement respecting the other side from a gentleman resident on the ground, and personally knowing to the facts.

It appears, then, that there is sufficient encouragement to justify an examination of these grounds in the usual way, and that it is decidedly proper to expend a sufficient sum in washing, upon all the branches, and in opening several of the veins of quartz on both sides of the river.

A person accustomed to the indications of gold in this region, would, in the course of a few weeks or months, be able to make up an opinion which might guide future researches or decide the previous question. There is a large tract of low meadow ground on the Mount Ephraim estate, which greatly resembles, in its general features, the grounds that are now profitably washed for gold at the Whitehall mines in Spotsylvania county: this tract ought to be examined by digging to the slate, and washing the gravel lying above it.

There can be no reason to doubt, that both in the washings of the alluvial matters and in the regular quartz veins, gold will be found. It is, however, impossible to predict in what quantity, but as rich disclosures of gold have been made in the immediate vicinity, as these tracts present the peculiar features of the gold region, and as some gold has been found upon them, a favorable result may be reasonably looked for, although nothing but actual trials will give full assurance. These tracts have important natural advantages. A great river, affording unlimited hydraulic power, passes through the lands. Their elevation above the water insures an easy drainage, and there is a large quantity of good timber; all these resources would, in case of actual mining, prove of great importance.

Remark.—In the experiments of a public course of chemistry, I have recently used portions of the gold which I extracted at the Virginia mines; it proved remarkably pure, and gave fine results in every instance in which it was tried.

Art. XI.—*Notice of some facts connected with the Gold of a portion of North Carolina;* in a letter to the Editor, dated Charlotte, (N. C.) June 6, 1831, from Franklin L. Smith, Esq.

Remark.—The publication of this letter, so many years after its date, demands an explanation, which will be given in another way to the writer. To the public it is sufficient to say, that it was called out from the files where it had lain so long, in consequence of the interest excited in the Editor's mind by his recent examination of the gold region of Virginia; and on account of the striking similarity of most of the facts stated in this letter, to those which he there saw, he now concludes to publish it, although at so great a distance of time from its date, believing that the facts are still valuable, and trusting that the author will forgive the delay.—Ed.

TO PROFESSOR SILLIMAN.

Dear Sir—Your letter, directed to the postmaster of this place, was by him handed to me some weeks since, and would have been answered sooner but on account of indisposition, which prevented me from complying with the request therein contained as soon as my own wishes would have dictated. Even now I feel a delicacy in writing upon a subject to which my limited mineralogical knowledge prevents me from doing adequate justice.

Before entering into a statement of the facts connected with the large quantity of gold lately found near this place, and to which your letter of inquiry refers, it will be necessary to premise, that the gold of this section of country is found in three separate and distinct situations, varying essentially, not only in their locality, but in the appearance exhibited by the metal itself, and the minerals with which it is connected.

The first and doubtless the most important situation, both as regards the certainty and continuance of its products, in which gold is found, is that of veins. Here it is found mingled with quartz and slate, (I speak in the common language of the country,) either in crystals of sulphuret of iron, or the sulphuret being apparently decomposed, and an oxide formed in the crevices of the rock, which give it the appearance and designation among the miners of honeycomb. The gold is found in veins, exhibiting peculiar and distinct appearances from that found, secondly, in alluvial deposits. These alluvial deposits, as their name imports, are found in valleys, and no doubt are produced by the washing from the veins of the adjacent hills. This seems probable from the fact, that the adjacent hills are in every instance, when examined, found to contain veins of gold more or less valuable—that the deposits themselves are at various distances from the surface, and that the pieces of gold, when found, whether pure or connected with quartz, always exhibit that peculiar rounded appearance which is produced by the agitation of water.

The third situation in which gold is found, and that which is most surprising, is that of deposits, or, to use the expression of the miners, "pockets," on the tops or declivities of hills. This differs from the first situation in not exhibiting regularly formed veins, and from the second in not showing any appearances of the form of the pieces found therein being produced by the friction of water, the gold, when found in this situation, seeming to be of a crystalline formation. These deposits or pockets are found at different distances from the surface of the ground, varying from a few inches to five feet. In this latter situation was found the large quantity of gold to which it is supposed you make allusion in your letter. I do not now remember the account given in the newspapers, but am led to believe it was somewhat exaggerated, as such is generally the case when new and extensive discoveries are first made. The facts of the case, it is believed, are these. On account of some indications that a piece of land, lying about eighteen miles in a southeast direction from this, contained gold, two persons from Virginia were induced, more than a year since, to purchase it. After some few ineffectual endeavors to find the precious metal, these persons deserted the land and returned to their homes. In the month of April last, while some laborers were engaged in a search for gold on the land, they discovered, on the top of a hill, about two or three feet below the surface, and in a red clay loam, formed it is presumed by the decomposition of slate, an extremely rich pocket of the kind above described. Such was the richness of this deposit, that in a space little if any exceeding three feet square, the workmen in a short time obtained, as I am assured by unquestionable authority, seventy five pounds of gold, one piece alone weighing nine pounds, two ounces, and seven pennyweights. This piece, when first discovered, was wedged in between a formation of quartz and slate, from which position it was with much difficulty removed, without breaking it into smaller pieces. Its shape was nearly triangular, with a base of eight inches, gradually but irregularly decreasing, until it was reduced to a vertex about two inches broad. It measured nearly thirteen inches in length, and was generally about an inch and a half thick, its surfaces exhibiting more the appearance of crystallization than that produced either by fusion or friction of water. When cleansed of the clay which was attached to this specimen of ore, it presented a solid mass of pure gold, except a small piece of quartz near the narrow end, and even this was intersected with numerous and beautiful veins of the precious metal.

This curious and valuable specimen was purchased in this place, by the Chevalier Vincent Riva Finola, superintendent of the English Gold Mining Company, for $1925, and by him forwarded to New York, and thence exported to Paris.

Before concluding, I would mention that the manner of working the different varieties of mines, as above described, are as various as the different situations in which they are found, and the appearances exhibited by the metal when obtained. A large capital is necessarily invested in working the vein mines, as extensive and expensive machinery is requisite to pulverize and wash the ore, to collect and purify the gold. The profits arising from the working of the vein mines, although occasionally not so exorbitant as are obtained from the others, are more sure and continual, as the veins, as far as experience yet has proved, are enlarged as their depth from the surface increases, and being moistened by water the ore is more easily obtained.

The working of the alluvial deposits requires much less capital, the only investment necessary being the price of the land and the hands employed in the labor—the gold in these situations being found in small pieces, generally pure; a small quantity of mercury, if any, is required to collect it; the machinery is extremely simple, and its expense comparatively nominal—many farmers, owning from ten to a hundred slaves, have found it advantageous to engage in the working of these alluvial deposits, as the profits in many instances are considerable, and even should the mine fail, their labor could with but little loss be turned into another channel.

The working of the third class of mines, "deposits or pockets," partakes of all that uncertainty and hope which constitute the attraction and intense anxiety of the gaming table. Whole months of labor may be expended without one particle of gold delighting the anxious eyes of the workman—when unexpectedly his labor may be repaid and his brightest hopes fulfilled by the discovery of a rich pocket, which may raise him from poverty to wealth. But these rich pockets, like lottery prizes and angels' visits, are few and far between, and it is only in the excitement produced by the discovery of some such valuable pocket as the one described in the preceding part of my letter, that prudent persons are apt to engage in their search.

I have thus, sir, in answering your inquiry, been led into considerable detail, but in it I have endeavored to confine myself strictly to points suggested by the inquiry. Indeed, were I to pursue the important subject of gold-mining, as followed even in this section of country, through all the ramifications which naturally suggest themselves to the mind, I might at once prove tedious to you, even if I should not furnish evidence of my inability properly to handle the subject.

ART. XII.—*Notice of the Shad and Shad Fisheries of the River Delaware;* by SAMUEL HOWELL, M. D.

(Communicated by Dr. RICHARD HARLAN, of Philadelphia.)

ANALOGOUS to the feathered tribes in their periodical migrations, are the shad of our Atlantic rivers; and like some of these, too, as the Rail bird for example, we are as yet ignorant whence they come and whither they go. In this respect they afford a striking illustration of the goodness and design of an all-wise Providence, in making it a law of their nature that they shall thus annually throw themselves within the reach of man, at a season when they are in the greatest state of perfection, and when circumstances render it most convenient for him to appropriate them to his use.

The shad usually make their first appearance about the middle of March; in early seasons, however, they are occasionally taken in February. It is a singular fact that they are caught within a few days as early above the rapids, one hundred and sixty miles from the ocean, as at the lowest fisheries on the river. But although their advance guard would thus seem to move on with such celerity towards their place of destination, the main body evidently pursue their course more deliberately: and it is obvious from the operations of the successive fisheries, that their progress upward is slow, and that they do not move as fast as the tide would carry them, even admitting that they remain quiescent during the ebb. While they work their way slowly against the ebb tide, it would seem that they head about and rather stem the upward drift of the flood. This is proved by the fact that the drift nets or gilling seines, which catch them meshed on their lower side during their ebb drift, have them entangled on the opposite side when drifting upwards with the flood tide. While their general movement is upwards, for their final destination seems to be the clear shallow waters above the tide, their instinct instructs them to loiter by the way to enjoy their appropriate food, with which the turbid fresh waters of the river seem to abound. What this food is, is conjectural; they certainly are not a fish of prey, and their alimentary canal on dissection, discloses nothing but a greenish, earthy slime, which is probably strained through their fringed throats, as they suck in the water; we may fairly infer that their nutriment consists of the mucilage or matters held in solution by the waters. That they find congenial aliment in these waters is obvious from the fact that they increase in fat and flavor the longer they remain in the rivers.

Whether all the myriads of shad which enter the Delaware annually would proceed to its head waters if unobstructed, is quite doubtful. There is some reason for believing, that like some of the migratory birds, they return annually to the parts of the river in which they were bred. How else are we to account for the marked difference observed in the shad taken in the different parts of the Delaware and its tributary streams? Those, for example, which are caught in the creek, are so small and so inferior in flavor to those taken high up the river, as almost to form a distinct variety of fish. The Trenton shad, or those caught at the falls, have, from time immemorial, been proverbial for their superiority in quality as well as size to those taken in the waters below.

It would seem that these fish enter the Delaware in successive "runs," or shoals, and the experience of all observant fishermen goes to prove that these "runs" make their appearance in *ordinary seasons* at definite periods. For example, there is commonly a scattering run from the middle of March to the middle of April. These are, for the most part, small in size, and not remarkable for flavor. From this period to the 25th of April occurs the great run; and this is felt at each successive fishery for nearly a week, if no storm occurs to drive them into deep water; for it is a fact well ascertained, that while in pleasant weather these fish swim near the surface, yet the moment a cold easterly wind commences blowing, they sink so near the bottom that the deepest nets will sweep over their usual grounds in vain. This run generally continues until the beginning of May, after which period the successive shoals that enter the river are small and scattered, until the termination of the season, which is usually about the 20th of June, though by an existing legislative restriction it is limited to the first of that month in the lower waters of the river, and to the tenth in the upper. The distinctness of these different runs, is proved by the appearance of the fish, by their quality, and by the state of roe in the female; those of the late runs being for the most part less forward than those of the great run in April.

The final cause of their annual visit is doubtless to seek a suitable place of deposit for their eggs, which probably require a temperature higher than that of the ocean, for their development; and a safe and appropriate *nursery* for their young during the early period of their existence, when they are of all others the most delicate. After having spawned, the old fish soon disappear. They are occasionally caught indeed in the nets, but they are thin and worthless, and from their attenuated condition, they are called by the fishermen "*racers.*" The young fish remain in the river until towards autumn, by which time they have attained the size of small herrings, when they in their turn disappear. They are caught in immense numbers in the weirs, and racks, and baskets which are constructed in the shallow waters above the falls, for the purpose of taking the common river fish, and they are so tender as to be destroyed by the least violence. These contrivances, so destructive to the young fish, have consequently become objects of legislative prohibition.

The destination of these fish, after they quit the fresh water, is unknown. I have never yet met with an authentic account of their having been caught or even observed at sea, nor have naturalists attempted to trace their route through the ocean, as in the case of the herrings. Their term of life cannot be ascertained, but it is fair to infer that they acquire their growth in a year, from the size to which the young attain during their short sojourn in our waters, as well as from the general uniformity of size observed in each of the several runs. Their average weight may be about seven pounds, but individuals are occasionally caught which weigh as high as twelve and even thirteen pounds.

The numbers of shad taken in the Delaware vary in different seasons. Perhaps it would not be far from the truth to estimate them at thirty thousand at each *shore* fishery. Formerly, when fisheries were fewer, the number far exceeded this amount. I have no data by which to estimate the number caught by the *gilling seines*, but from the rapid multiplication of these destructive contrivances it must be very great. The aggregate amount taken annually by the shore seines and the drift nets, is probably not far short of one million five hundred thousand, which at seven dollars per hundred, would be worth upwards of one hundred thousand dollars.

The principal market is Philadelphia; but immense numbers are vended at the fisheries, to which people flock from all quarters in wagons and boats. The writer has known sixty and seventy wagons supplied in a day, (each perhaps taking at least one hundred,) at the Fancy Hill fisheries, six miles below Philadelphia. The great mass are salted like mackerel, and chiefly for domestic use. In the fresh state they are, in the height of their season, one of the most delicious of any of the finny race, and decidedly the best mode of cooking is that called "planking," which consists in nailing the fish to a clean oaken plank, previously heated, and setting it before a brisk fire. By this method the juices of the fish are all preserved. They are sometimes treated like hams, viz. by rubbing them with fine salt, salt-petre, and molasses, and smoked for a few days, and in this way are very superior to those cured with salt alone.

The usual and most efficient method of taking the shad is by means of seines. These however are applicable only to the deeper waters; in the current, viz. above the tide, amongst the shallows, various other contrivances are used to entrap them. Until within a few years there was but one kind of seine used; this varied in length according to the extent of the range, the width of the channel, and rapidity of the tide or current, as the case might be; its breadth being proportioned to the depth of the water but tapering towards the ends. Both margins are connected with a stout line or rope, the one armed with oblong cedar blocks called corks, presenting the appearance of a string of beads, to support the upper margin at the surface of the water, the other being naked, or sometimes rendered more heavy by the addition, at intervals, of pieces of sheet lead to keep it near the bottom. These lines are joined near to each extremity of the seines and are there called the brails, to each of which are attached the ropes by which the net is to be drawn to the shore. Thus constructed, the net is placed on the stern of what is called the seine-boat—a large barge-like boat, long and narrow, and having a sort of platform in the stern, upon which the net and lines are carefully coiled. The boat being rowed to the proper starting place, the line which is to connect the net with the shore is then taken by a part of the crew, called the landsmen, who are posted on the shore at the starting place, and the boat is rowed out into the river, the residue of the land line and the net gradually running off as the boat recedes, until the whole is dropped into the water, the boat gradually rounding to and approaching the shore, so as to give to the net the form of a crescent, the arms of which being in the direction of the current, so as to gather in as many fish as possible during the drift of the seine. On reaching the shore, the boat's crew seize the line connected with the outer end of the net, called the water line, which was also coiled away in the boat, and both divisions of the crew now commence drawing in their respective ends, gradually "dropping down," as it is called, so as to keep "abreast" of the drifting seine, until each is finally brought to land; when the two ends have reached the shore, the fish are completely enclosed. The next process is called landing; to effect this, the men at each end lay hold of the cork and lead lines of their respective ends, and draw them together, pulling as uniformly as possible so as to keep up a simultaneous movement, the lead line of each end being kept near the bottom by a "holder down," as he is called, whose duty it is to press down this line with his foot, allowing it to slip at every pull of the men who are drawing in the net. In this way they soon reach the central part or bag of the seine, when those pulling upon the sunken line necessarily meet, and the contents of the net become enclosed within the small space between its marginal lines; this is called bagging up. It now only remains to transfer the fish into the market-boat, which is effected by means of scoop or hoop-nets—small hand-nets, managed by a single man, and capable of holding about twenty fish, and this is called bailing.

It is an interesting sight to witness these operations during a fine run of shad, when they are occasionally taken in hauls of thousands. To see the water within the seine black with their backs and bristling with their fins—to witness the animation and bustle of the fishermen, and behold their eagerness and anxiety to secure their booty, are circumstances calculated to excite in the spectator of such an enlivening scene, emotions of delight, and cause him to participate with the successful fisherman in all his joy and hilarity. The writer once witnessed the landing of ten thousand eight hundred shad taken at a single haul—the greatest by many thousands ever made in the river Delaware before or since.

The regular shore-nets vary in length from one hundred and fifty to five hundred fathoms. Formerly they were drawn in by manual labor alone. Of late years, however, capstans have been employed to aid in this laborious operation. The number of men required to manage a net varies from fifteen to twenty five. The whole number employed at the Fancy Hill fisheries, including foremen, clerk, market-men, tide-watchers, &c. is nearly one hundred.

Besides the production of such an amount of healthful and delicious food, in quantity generally sufficient to supply the states of Pennsylvania and New Jersey, the fisheries give profitable employment to a great number of men, at a season when their services are not particularly required in agricultural labor. The fisheries, therefore, constitute an important interest to the states bordering on the river, and one that merits the fostering care of their respective legislatures. The importance of this species of property was recognized at an early period of our history, when fisheries were comparatively few, and numerous salutary provisions were enacted, from time to time, in relation to them, whose object was to perpetuate their benefits, and to secure them to their rightful possessors. Amongst others, were those protecting the fisheries from unnecessary interruption by vessels and rafts, which are expressly required to avoid the seines while fishing, and prohibited under severe penalties from anchoring *within* the fishing range of any of the fisheries. But of late years the legislatures of these states have been so occupied with political maneuvering and management, that they seem to have lost sight of many of the best interests of their respective states, and amongst others of the fisheries; for while they are compelled to pay heavy taxes into the state treasury, in common with other real property, and are subject to several onerous restrictions, which have been artfully imposed upon them, upon the ground of preserving the breed of fish, they have been so far neglected by their legal guardians, that the river has of late been virtually thrown open to common right, and a class of outlaws—men without a local habitation or a name—are now enjoying privileges and rights, without the shadow of benefit to the respective states, which laws and usages from time immemorial had secured to the riparian proprietor. I allude to the gill-net fishermen, who have literally taken forcible possession of the river Delaware, under the plea of its being a common highway, and have virtually dispossessed the lawful owners of the fisheries of property which they considered as secure, and as much their own as their farms. The several right of fishery had been the fruitful source of litigation in this country from an early period of its history; but it had been so long recognized by legislative enactments, and confirmed by the decisions of the highest judicial tribunals, that the question seemed to be finally and incontrovertibly settled. This right too seemed to be effectually secured to the riparian proprietor, by the circumstance that it was necessary, in order to its enjoyment, that a foothold should be had on shore, whereupon to manage the seine and to secure its contents. This, of course, would subject any person who attempted to encroach on the fishing rights of another, to an action of trespass, and consequently operated as an effectual protection. But the ingenuity of man, ever ready to evade restrictions that clash with his interests, has devised a mode of fishing by which all connexion with the shore is rendered unnecessary, and which, although prohibited by statutory enactments, he is able to practice in utter disregard of law or authority. By this method, the net is so constructed as to enlarge or to mesh, as it is technically said, and not to enclose the shad, as is the case with the regular shore nets, already described. The seine used by these *freebooters* is formed with meshes so large that the fish are permitted to pass their heads through, and on attempting to retreat they become entangled by the gills. The twine too of which the nets are made, is so fine that it is not perceived by the fish, until his head is in the toil and it is too late to escape. These nets are kept extended by means of a small boat at each end, across the main channels, and thus extended they are permitted to drift for miles, until they have become loaded, when they are taken into the boats, the fish secured, and they are again stretched off in the river as before. These contrivances are hence denominated drift nets, or gilling seines, and although prohibited by law, yet so lame are its provisions, that it is morally impossible to enforce it, except in cases where the name of the offender can be ascertained. These marauders, therefore, emboldened by the impunity with which they are enabled to carry on their predatory operations, have increased to such an extent as already greatly to depreciate the shore fisheries, and if not checked, they must, ere long, render them worthless.

ART. XIII.—*Formic Acid—remarks upon its utility, together with a correction of Döbereiner's Process and views respecting the theory of its formation;* by Prof. J. P. EMMET, of the University of Virginia.

EVERY day brings evidence of the success which Chemistry bestows upon its votaries, in closely imitating some of the numerous productions which are generally regarded as being strictly limited to the influence of a vital power. Examples are already too numerous to make it requisite that the opinion should be sustained by their aid upon the present occasion; I shall therefore confine myself to the very striking instance furnished by the subject of this communication.

The *formic acid,* as the name implies, was at first detected in ants. It exists as a peculiar secretion which they emit when provoked, and, at one time, the only mode of procuring it consisted in macerating or bruising these insects in water and afterwards submitting the mixture either to simple pressure, or to distillation.

It is sufficiently obvious, however, that the product must have been both weak and impure. With the formic acid, thus obtained, exists the malic acid; and to separate the latter, as well as to give the necessary concentration, the acids were neutralized by carbonate of potassa, (without excess)—the malic acid then precipitated by acetate of lead, (added only as long as precipitation took place,) and the solution of the formate, thus left, when sufficiently concentrated, decomposed by means of sulphuric acid. Subsequently, distillation was necessary in order to obtain the formic acid itself; yet, even after this, one impurity being substituted for another, (the acetic for the malic acid,) it would become necessary to have recourse to the additional operations of combining the acids with the oxide of lead, and then separating their salts by well managed crystallization, before we could obtain the formic acid free from the acetic.

It is manifest that an acid, with so very limited a source and so many delays accompanying its preparation, was but ill calculated to excite much general interest. Even after Döbereiner had pointed out the mode by which it could be obtained *artificially*, and Wöhler, Liebig and others, had very much extended the list of substances capable of yielding it by this process, there was found to exist much practical inconvenience, and the formic acid still continues to be known to many chemists, only by description. The last specimen which I purchased cost 50 cents per ounce, although its intrinsic value should not exceed 6¼ cents, when proper and obvious precautions are taken in its formation.

To the taste this acid is very nearly as grateful as the best vinegar, and, at the same time, so very similar, that one might be substituted for the other by housekeepers. Most persons would certainly confound them, for even the distinguished chemists, Fourcroy and Vauquelin, not only deliberately published their conviction of the identity, after an experimental inquiry which had this express object in view, but again asserted the same opinion when their first statement was opposed by the experiments of Suerson, who contended that the formic was a distinct and peculiar acid. The acetic and formic acids have an origin very similar, both coming from the same class of bodies, viz. sugar, starch, gum, wood, &c. By a species of destructive distillation peculiar to each, both may be got from these substances *directly;* but the acetic acid does not appear to yield any notable quantity of the formic, by any operations yet known. In addition to the evidence which H. Braconnot has given, that the former one is frequently generated by living vegetables, I will here notice an instance, founded upon my own observation, of a very striking nature. Being lately very much struck with the odor peculiar to the red oak, I applied my lips closely to the transverse section of some fresh cut logs, and, to my astonishment, sucked up with ease a pure and grateful vinegar, sharp to the taste, and so like the best specimens of the acetic acid that distillation could not have improved its qualities. The tree was full grown and sound, and felled in the month of February, about the 6th, and the wood examined as soon as cut. The acetic acid existed most abundantly in the red portion next to the heart.

In some of the arts, where pure acetic acid of medium strength is required, (as in making white lead,) it appears to me that the formic acid might be substituted; for, independently of the fact that the latter may be procured *pure and concentrated by a single distillation* from the same bodies which, *indirectly, and only by an expensive process*, furnish the acetic acid,—their neutralizing powers, are widely different, and the advantage is greatly in favor of the formic acid. The combining proportions being as follows: *acetic acid* 50, *formic acid* 37, it follows that the difference of weight, which amounts to nearly one fourth of the whole acetic acid, would be always available were the formic acid employed for the purposes of saturation.

This acid, however, can never be brought to the same degree of concentration, because, its elements being in such a ratio as to represent, exactly, 2 *atoms oxide of carbon*+1 *atom water*, it readily suffers decomposition when exposed to the influence of sulphuric acid strong enough to remove its constituent water. This, of course, always happens when a formate is decomposed by the commercial sulphuric acid, and nothing can be more characteristic of the presence of formic acid than the *brisk effervescence*, owing to the escape of pure oxide of carbon, whenever the dry formates are heated with oil of vitriol. There is no odor of formic acid. The acetates, on the contrary, as is well known, furnish the strongest and purest acid when submitted to the same treatment. But although this may be regarded as a defect for some purposes, the formic acid, obtained by decomposing its salts, need never contain more than 20 per cent. of water.

To the chemist and pharmaceutist, the formic acid is highly interesting in consequence of its surprising *reducing power;* being, in this respect, superior even to hydrogen. Like the lampic acid, it often promptly revives the noble metals when saline solutions of the latter are made to boil previous to the addition of the acid; but so perfect is the reduction and precipitation when a *formate* of potassa or soda is employed instead of the uncombined acid, that Döbereiner and others have strongly recommended the process, when chemists are desirous of separating the precious metals from the common or more easily oxidizable ones.* M. Göbel has also shown, that by simply combining the oxides with formic acid, and heating the dry salts thus obtained over a spirit lamp, it is easy to procure, in a state of perfect reduction, the metals zinc, copper, cadmium, bismuth, lead, *nickel*, *uranium*, *cerium*, and *cobalt*.†

The mode of action is obvious, and the facility of reduction equally intelligible. The *oxide of carbon*, composing the formic acid, removes oxygen from the metal and becomes *carbonic acid*, generally leaving the reduced matter surrounded by the excess of the former gas. Carbonic oxide, even when completely gaseous, combines freely with oxygen at a dull red heat, as was shown by Davy, and therefore, in the above examples, where these substances have the additional advantage of previous condensation to the solid state, the formic acid must be very superior to hydrogen when the temperature does not much exceed obscure redness. It is, in fact, together with carburetted hydrogen, the great reducing agent in all furnace operations; for the carbon of the fuel, while in its solid state, must be nearly inoperative at all times, and the carbonic acid which appears so abundantly in all such cases, if the reduction of the ore be complete, should never acquire more than one half of its oxygen from the *air* which enters the furnace. Formic acid, it is obvious, will enable the chemist not only to recover the metal, but to determine accurately the quantity of oxygen with which it was combined—whether the oxide be a *per* or *prot*-oxide, the principle is the same—a given weight of it is to be boiled with formic acid *in excess*. The latter being always decomposed by the operation, furnishes carbonic acid, every atom of which contains an atom of oxygen obtained from the metal; and by the same data, when the *oxide is in excess*, the whole of the formic acid being decomposed into a mixture of carbonic oxide and acid, we have only to collect, separate and determine the amount of each of these gases, in order to arrive at a knowledge of the quantity of formic acid that existed in the solution operated upon. If the reduction of the *per*-oxide be complete, the formic acid will be resolved into water and carbonic acid alone, which would simplify the process very materially, but such a result can hardly be looked upon as quite accurate, notwithstanding M. Göbel's strong recommendation, because the formic acid is very volatile, and a portion must, therefore, always escape decomposition.

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* Annales de Chim. Jan. 1833.

† Journal de Pharm. Tome xix. p. 485.

From what has been remarked upon the decomposition of formates by strong sulphuric acid, it will appear obvious that chemists possess an easy, direct, and certain method for obtaining oxide of carbon, uncontaminated by carbonic acid.

In many operations of pharmaceutical chemistry, great advantage might be taken of the remarkable properties of formic acid; for, by its power of removing oxygen, it is capable indirectly of decomposing *chlorides*, which of course contain not a particle of this element. The fact is shown by the promptness with which, by simple ebullition, it changes *corrosive sublimate* into *calomel*, the process being at once so easy and satisfactory as to have induced Döbereiner strongly to recommend its adoption; and the rationale will be intelligible by referring the result to the combined agency of the chlorine for *hydrogen*, and the oxide of carbon for *oxygen*, both of the elements of water being derived from a portion of this fluid, present at the time, and either existing free, or being a constituent of the formic acid itself.

An agent which can thus promptly act upon metallic solutions, so as to effect reduction, is at once so peculiar and useful to persons engaged in chemical operations, that it only requires to be cheap in order to become extensively employed. This, I am satisfied, may be made the case.

The conversion of the formiate of ammonia into prussic acid, by simple exposure to heat, and the facility with which the latter yields formic acid when under the influence of strong muriatic or sulphuric acid, are peculiarities well worthy of attention, and have been distinctly brought to notice by M. J. Pelouze.* Formate of ammonia has, in fact, the composition, exactly, of an atom of prussic acid, combined with three atoms of water, and, when exposed to heat so as to separate the water, actually furnishes hydrocyanic acid of great strength; but it is not the less remarkable that the same formate of ammonia, even in very large doses, as was shown by M. Künckel, produces no injurious effects upon animals, neither does it occasion the production of Prussian blue. The cyanide of potassium, which bears exposure to a red heat without suffering decomposition, readily changes into ammonia and formate of potassa, by simply boiling a saturated solution of it in water.

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* Annales de Chim. Dec. 1831.

It is known, moreover, to chemists, that oxalic acid, when suddenly heated to about 300°, becomes changed into formic acid mixed with the oxide and acid of carbon and water. More recently, J. Liebig has examined a remarkable acid, composed of the formic acid and the hyduret of Benzule, (oil of bitter almonds,) to which he has given the name of formo-benzoilic.* Indeed, it seems remarkable, considering all circumstances, that formic acid does not more frequently arise from the reaction of organic bodies upon each other, and the more especially as there is some reason to presume, with Liebig, that *oxide of carbon,* like some compounds of carbon and hydrogen, is capable of acting as a radical. Perhaps the reason is, that formic acid contains elements feebly united, and (as has been stated in relation to the metallic oxides) readily seizes upon additional proportions of oxygen, and thus changes into carbonic acid and water.

The following, founded wholly upon a comparison of combining proportions, may be mentioned as some of its most direct relations:

One atom of formic acid may result from	1 atom of oxalic acid	+ 1 atom of hydrogen.
	1 atom of sugar	+ 1 atom of carbonic acid.
	3 atoms of sugar	— 1 atom of light carburet of hydrogen.
Two atoms of formic acid, from	1 atom of tartaric acid	+ 1 atom of oxygen.
	1 atom of malic (or citric) acid	+ 2 atoms of oxygen.

Also, 1 atom of formate of ammonia from 1 atom of prussic acid + 3 atoms of water.

Artificial preparation of formic acid.

I shall now, however, enter upon what must be regarded as the principal object of this communication; namely, a statement of the results of my own inquiry, by which I have arrived at the conclusion that Prof. Döbereiner's views are erroneous as to the mode of forming this acid, and that the principles involved in its production are analogous to, and perhaps equally deserving of notice as, those that relate to the hydric or sulphuric ether.

One part of tartaric acid (or sugar)—one and a half of peroxide of manganese—one and a half of sulphuric acid, diluted with about two and a half parts of water, when well mixed and subjected to distillation, will furnish the formic acid according to Döbereiner's process. In order to diminish the inconvenience arising from the frothing of this mixture, and which is exceedingly great, it is directed to add only half the amount of dilute acid at first, and to make use of a retort having five or six times the bulk of the matter to be put into it.

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* Ann. de Chim. Juin, 1836.

The explanation given by Döbereiner, and other chemists, assigns to the *peroxide of manganese* an agency absolutely necessary for success, viz. that, while it parts with a portion of its own oxygen and combines, as the protoxide, with sulphuric acid, it is enabled by the oxygen thus detached, to convert the tartaric acid (or sugar) into *formic* and *carbonic acids*.

The whole of this explanation is, however, incorrect, as will appear from the following results of my inquiry.

1. The presence of peroxide of manganese, (or any other peroxide,) is not only *unnecessary*, but positively injurious and productive of much inconvenience. It is positively injurious in consequence of the power which all peroxides have of decomposing formic acid, and productive of inconvenience in consequence of the vast amount of carbonic acid which it produces with the formic acid and the carbon, deposited during the operation. The latter is, in fact, the cause of the excessive frothing.

2. Sulphuric acid is not essential. The formic acid was prepared by phosphoric acid as well as by the chloride of tin; and no doubt all other substances, capable of converting alcohol into ether, may be shown to possess the same power. In no case does sulphuric acid, phosphoric acid, or chloride of tin undergo any decomposition, unless incidentally.

3. The formic acid may be procured from almost every kind of vegetable matter that is capable of being promptly blackened by contact with strong sulphuric acid. It *rarely* appears previous to the carbonization,* and *only* when the sulphuric acid possesses a powerful affinity for *water*.

It would appear, from these particulars, that the process for obtaining formic acid artificially is analogous to those operations for converting cotton, ligneous matter, &c. into gum—gum or starch into sugar, and alcohol into ether or olefiant gas, as far as regards the integrity of the sulphuric acid; but, in another respect, namely, the abundant deposit of carbon, previous to the escape of the formic acid, the action more resembles what occurs when alcohol changes at once into carbon and olefiant gas. The resemblance is still closer, if, as I suppose to be the case, the agency of the sulphuric acid consists in removing *water*, or its elements, from the organic substances which yield the formic acid when under its influence. I have mentioned that the phosphoric acid may be substituted for the sulphuric. In the experiment to determine this, the absence of the latter acid was accurately proved by muriate of baryta; starch was employed, and the phosphoric acid had the consistency of syrup. But although important for the investigation, as a fact, the substitution really cannot, in practice, be made with advantage, because the phosphoric acid has not the same degree of affinity for water, and before the essential action occurs, (well indicated by the separation of carbon,) the organic matter becomes decomposed, more or less, from simple exposure to heat, which thus imparts to the formic acid an unpleasant empyreumatic taste. The same remark applies to the *chloride of tin.*

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* When the chloride or sulphate of tin is employed, perfect carbonization does not take place, yet the formic acid is generated readily. There is no doubt, however, that some variety of carbon separates at the same time. Sugar, for example, gave a large deposit of a snuff brown color, and resembling in its properties, the *ulmin* of rotten wood.

There is little doubt, therefore, that, under the influence of strong sulphuric acid, gum, sugar, starch, lignine, &c. bear the same general relatio nto *formic acid*, and the latter to *oxide of carbon*, that *alcohol* does to *hydric ether*, and the latter to *olefiant gas* or etherine. Thus,

Sulphuric acid, by subtracting
Water from *Alcohol*—furnishes *hydric ether.*
Water from *Sugar, &c.* " *formic acid.*
Water from *Ether,* " *olefiant gas.*
Water from *Formic acid,* " *oxide of carbon.*

By a comparison of combining proportions, it will be seen that this explanation enables us to dispose of all the elements except two of hydrogen.

Thus, by adopting $(C+O+H)$ as the formula for one atom of *sugar;* and, supposing *four atoms* to be the smallest amount involved in the process, we will have $(4\,C+4\,O+4\,H)$, from which subtract $\dot{H}$, or one atom of *water*, (removed by the sulphuric acid,) and we shall have $4\,C+3\,O+3\,H$, which is equivalent to one atom of *formic acid* $(2\,C+3\,O+H)$ together with 2 *carbon*, precipitated, and 2 *hydrogen*, unaccounted for. Again; assuming $(6\,C+5\,O+5\,H)$ as the formula for one atom of *starch*, and subtracting $2\,\dot{H}$, or two atoms of water, removed by the sulphuric acid, the remainder will be equivalent to one atom of formic acid, $(2\,C+3\,O+H)$ together with 4 atoms of carbon deposited, and 2 atoms of hydrogen unaccounted for.

During the preparation of formic acid by Döbereiner's process, as well as by my own, in which no peroxide of manganese is employed, there is always formed, previous to the carbonization, a considerable quantity of *volatile oil*, which, at first, might be considered as arising from the excess of *hydrogen* and carbon in the process; but a special inquiry has convinced me that this is not the case, although the oil is so abundant that it may actually be observed floating in drops down the neck of the retort. When the sulphuric acid is so far diluted as not to carbonize the mixture at the heat of boiling water, little else than this spicy oil passes over by distillation; but as soon as the matter becomes black, its formation ceases, and if we begin at once with sulphuric acid about one half diluted, it does not appear at all; but, instead of it, strong formic acid, without any foreign odor, and quite colorless. This volatile oil would not be regarded as objectionable by many, since it imparts an aroma to the acid like that of cassia or cinnamon, and a taste somewhat similar to that produced by hydrocyanic acid.

The process which I recommend, as having been found the most convenient and perfect, for obtaining strong formic acid, is the following.

Mix together in a glass tubulated retort, equal measures of *water*, *oil of vitriol*, and clean, but unground *rye*, (or cracked maiz)—let them be heated to the boiling point, and, as soon as the mass has become thoroughly blackened, add another measure of water and distill off one measure of formic acid.

By the addition of a further quantity of water, and by fresh distillation, a weaker acid may be obtained, which will answer very well to be added in subsequent operations. Besides being too weak, the product of this second distillation will often contain some *sulphurous acid*, which seldom appears in the first, and never is essential to the process. It occurs in company with oxide or carbonic acid, and may be removed by agitating, for a short time, the *cold* formic acid with peroxide of lead, as recommended by Berzelius.

By employing the whole grain, when small enough, as of rye, wheat, oats, &c. and in the great proportion here recommended, the contents of the retort become too solid to froth up easily, so that the medium sized vessels may be employed. Indeed, still smaller ones may be substituted, by simply allowing water to enter through a dropping funnel at the tubulure, in proportion as it is removed by the distillation.

ART. XIV.—*On the Identity of the Torrelite of* THOMSON *with Columbite;* by JAMES D. DANA, A. M., Assist. in the department of Chem. Min. and Geol. of Yale College.

Read before the Yale Nat. Hist. Soc. Feb. 21, 1837.

IN a late number of the Records of General Science, (Dec. 1836, IV. p. 407,) Dr. Thomas Thomson has proposed a separation of the Columbite of Middletown, in this state, (Connecticut,) from the species heretofore designated by that name, and has denominated the supposed new species *Torrelite*, in honor of our distinguished countryman, Dr. Torrey. He has been led to this result, by the dissimilarity which he appears to have obtained, between the specific gravity, hardness, and composition of a specimen from the above locality, and the same qualities of the Haddam and Bohemian specimens. From an imperfect, and evidently very irregular crystal, he has also deduced a primary form, distinct from that of Columbite. The author of these remarks, having had the pleasure of examining several of the splendid crystals, remarkable for their regularity and brilliancy, afforded by the Middletown locality, would here state what appear to be the obvious deductions from these crystals, respecting the propriety of the above distinction. It should be premised, however, that although the conclusion deduced may differ from Dr. Thomson's, yet considering the apparent rhomboidal form of the only crystal in his possession, and also the other discrepancies which he observed, we must regard his conclusions as a fair deduction from the facts observed.

The identity of the Haddam and European specimens was clearly exhibited by Dr. J. Torrey, by means of figures and descriptions, in the Annals of the New York Lyceum, Vol. I. page 89. The first of the following figures is copied from this article. To facilitate comparison, a representation by Mr. Brooke, of a crystal in his possession, (Fig. 2,) supposed from Bodenmais, in Bavaria, is added. The general forms of these figures are modified rectangular prisms.

Mr. Brooke obtained the following angles:

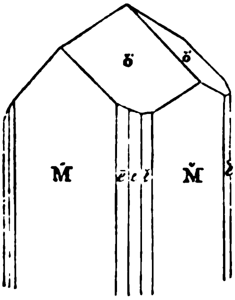
$P : \breve{o}' = 136^\circ\ 30'$ $\breve{M} : \breve{e} = 156^\circ\ 30'$
$P : \breve{e} = 120^\circ$ $\breve{M} : \bar{e} = 114^\circ\ 30'$

With the reflective goniometer, Dr. Torrey found

$\breve{M} : \breve{e}$ and $\bar{M} : \bar{e} = 157^\circ$ $\breve{M} : e = 129^\circ\ 50'$ $\breve{M} : \bar{e}' = 102^\circ\ 50'$

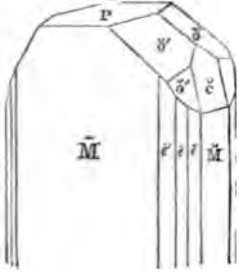
The angles $\breve{M} : \breve{e}$ approximate sufficiently to prove an identity.

Fig. 1.



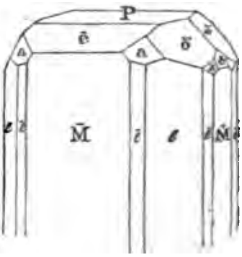
1. Haddam, Conn.

Fig. 2.



2. Bodenmais, Bavaria.

Fig. 3.



3. Middletown, Conn.

The specimens from the localities that afforded these two crystals are correctly recognized by Dr. Thomson as belonging to the same species. A simple inspection of figure 3, a representation of a Middletown specimen, seems to lead to the same conclusion respecting *its* relation to the Bodenmais Columbite. This will be rendered more apparent by comparing with the above the interfacial angles of this crystal. These angles have been obtained by calculation; they are necessarily founded, however, on previous measurements, with which they very closely agree.*

P : a=126° 2′
P : ŏ′=136° 36′
P : ŏ″=119° 13′
P : ĕ=119° 40′
P : ē=160° 34′
M̆ : *ĕ*=158° 6′
M̆ : *e*=129° 40′
M̆ : *ē*=112° 31′
M̄ : *e*=140° 20′

a : a (over ŏ′)=102° 58′
a : a (over ē)=117° 51′
a : a (over *e*)=107° 56′
ŏ′ : ŏ′=150° 17′
ŏ″ : ŏ″=160° 29′
a : ŏ′=156° 20½′
a : *e*=143° 58′
ĕ : ŏ″=170° 14½′
e : *e*=100° 40′ and 79° 20′

In the calculations of these angles, the planes a, were assumed as the faces of the fundamental form. We hence obtain for the values of the crystallographic axes, $a=1.0584=\sqrt{1.12}$, $b=1.206=\sqrt{1.454}$, $c=1$; and by inspection and calculation deduce the annexed description of the crystal according to Naumann's system of notation:

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* The following values of these angles have been observed by C. U. Shepard, (Shepard's Min. II. 323.)

P : a=127°
P : ŏ′=137° 20′ ?
P : ē=160° 23′
M̆ : *ĕ*=157° 40′

M̆ : *e*=129° 30′
M̆ : *ĕ*=112° 10′
ŏ′ : ŏ′=149° 30′
a : *e* = 144°

$$\begin{array}{cccccc} 0P\ . & \tfrac{1}{3}\bar{P}\infty\ . & P\ . & \breve{P}3\ . & 2\breve{P}6\ . & 2\breve{P}\infty\ . \\ P & \bar{e} & a & \breve{o}' & \breve{o}'' & \breve{e} \end{array}$$

$$\begin{array}{ccccc} \infty\bar{P}\infty\ . & \infty\bar{P}2\ . & \infty P\ . & \infty\breve{P}3\ . & \infty\breve{P}\infty. \\ \bar{M} & \bar{e} & e & \breve{e} & \breve{M} \end{array}$$

A comparison of the above angles, leaves no doubt that this crystal is a specimen of the species Columbite: and we may extend this remark to all the specimens from the same locality; for perfect crystals, affording the same angles, are of frequent occurrence. The crystal figured by Dr. Thomson is so very irregular, that it cannot be considered an exception to this remark. It presents but one replaced lateral edge, and one replaced angle, which sufficiently indicate that little or no reliance can be placed upon its apparent form. According to Dr. Thomson's measurement, M : T (mean of 5 trials)=84° 20′, T : *e* (plane replacing the acute lateral edge)=152°, M : *e*=110° 20′, a : *e* (inclination of the plane on the angle, to the adjacent lateral edge)=143° 45′. The last inclination nearly coincides with the interfacial angle a : *e* as above given. This close approximation would authorize a suspicion of the identity of the crystal examined by Dr. Thomson, with the more regular and highly finished individuals so frequently afforded by the locality. The crystals from Middletown, though often minute, occur occasionally of a gigantic size. Prof. Johnston, of the Wesleyan University, has lately described a fractured crystal which originally weighed 14 lbs.* His description is accompanied with a figure of the larger fragment into which it was broken. Its weight was 6 lbs. 12 oz. avoirdupois, and in length and breadth it exceeded seven inches. Its general form was similar to the above figures, and it presented the faces $\breve{M}$, $\bar{M}$, *e*, $\bar{e}$, $\breve{e}$, $\breve{e}$, and another imperfect plane, which appears to be $\breve{o}'$.

From the identity in the crystallization, therefore, of the Middletown and Bodenmais specimens, we are compelled to assent to their continued union in the same species. Slight discrepancies in the physical characters, if they actually exist, should not influence the decisions arising from crystallographic examinations with well defined crystals. I have not, however, found the discrepancy in the specific gravity, noticed by Dr. Thomson. A fragment of a crystal weighing about 52 grains, afforded by one trial 5.95, and by a second, 5.948 for its specific gravity, which is a near approach to that of the Bodenmais Columbite, which is stated at 6.038. Mr. Hatchett obtained, for the American specimen in the British Museum, 5.918. The specific gravity was determined by Dr. T. at 4.8038. There is, however, as stated by Dr. T. a very evident difference in hardness. I have found it to vary from 5 to 5.5. The Haddam and Middletown specimens afford a dark reddish brown, or brownish black streak, and very frequently present the blue, reddish or yellowish tints of the steel tarnish.

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* See this Journal, xxx. 387. The Columbite at Middletown occurs irregularly disseminated in a coarse granite, containing mica and feldspar in large crystalline masses. This feldspar has been quarried for the manufacture of porcelain, and by this means the fine specimens of Columbite which the locality has afforded, have been disclosed. Albite and small quantities of uranite, rutile and apatite are associated with the Columbite.

The composition of the Bodenmais and American Columbite has been variously stated by different analysts. The following are the results of analyses by Borkowsky, Vogel, Thomson and Wollaston:

	Bodenmais.	Bodenmais.	*Torrelite*, from Middletown, Con.	Bodenmais.	Connecticut.
Columbic acid,	74.0	75	73.90	79.65	80
Protoxyd of iron,	20.0	17	15.65	14.00	15
Protox. manganese,	4.6	5	8.00	7.55	5
Oxyd of tin,	0.4	1	——	0.50	—
Water, . .	——=99 B.	—=98 V.	0.35=97.9 T.	0.05=101.75 T.	—=100 W.

The last analysis by Wollaston, was made with but 5 grains of the original specimen in the British Museum. The results of these analyses are not so widely different as to excite a doubt respecting the correctness of the conclusions from crystallographic considerations.

There is yet much uncertainty with respect to the identity of the *Finland* Tantalite with the species Columbite. Its superior specific gravity, (7.2 to 7.3,) and slightly different composition, seem to require their separation. Gustav Rose, in his Elements of Crystallography,* p. 168, has proposed this separation on crystallographic grounds, and has included, as above, the Bodenmais and "Massachusetts" (Connecticut?) specimens in the species *Columbite*, and those from Finland under the separate name of *tantalite*. It would appear, however, that he was not acquainted with the crystallization of the American specimens; for he arranges the species Columbite in the Monoclinate system of crystallization, (his Zwei- und eingliedriges Krystallisation-system,) and retains the Tantalite only in the Trimetric system, (his ein- und einaxiges Krystallisation-system.) Mr. Rose however remarks, that the only specimen he has observed which leads to this conclusion, was a large crystal in the Berlin Museum, with faces too uneven to admit of measurement, and concludes by observing that other examinations would be required, to establish the certainty of the above conclusions. This subject, therefore, still remains in doubt, and can be cleared up only by accurate crystallographic examinations. The Tantalite from Finland afforded Berzelius, Columbic acid 83.2, Protoxyd of iron 7.2, Protoxyd of manganese 7.4, Oxyd of tin 0.6 = 98.4.

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* Elemente der Krystallographie nebst einer tabellarischen Uebersicht der Mineralien nach den Krystallformen. 174 pp. 8vo. with 10 copper pls. Berlin, 1833.

ART. XV.—*On the Causes of the Tornado, or Water Spout;* by R. HARE, M. D. &c. &c.

IN July last, I visited the scene of the tornado, which had in the previous month produced so much damage in and near New Brunswick, New Jersey, and heard it described by various witnesses, and have likewise been edified by the observations made respecting its effects by Professors Henry, Torrey, Johnson, and other sagacious and learned observers, and especially those of my friends, Prof. A. D. Bache and Mr. Espy. Probably in no other instance have the effects of a tornado been so faithfully and skillfully traced, ascertained and registered. Prof. Bache regularly surveyed the path of the devastating agent, and ascertained the bearings of the various bodies prostrated by it, so as to make several accurate plots. From an examination of these, the proximate causes of the changes effected, are those of a vertical current at the centre or axis of the tornado, aud of a horizontal conflux of the air towards that axis from the surrounding space. Some trees appear to have been thrown down on the approach of the hiatus, both directly in front of it and on either side; some fell at right angles, others obliquely to the path. Hence they were found to have a great variety of bearings, but always pointing towards the path. The time of their falling, and consequently the direction agreeably to the observations of Prof. Bache, appear to have been determined not only by the extent of the force to which they were exposed, but likewise by the strength of their roots, or the degree of protection afforded them by other bodies, trees or houses for instance. On these accounts, neighboring trees, falling at different times, had different bearings; but that they all fell towards the point occupied by the axis of the tornado at the time of their overthrow, appears to be consistent with the facts. In one instance, both Prof. Bache and Mr. Espy observed that the post of a frame building, being dislodged from the stone on which it rested, was first moved towards the path of the tornado in one direction about eighteen inches, marking its course by a furrow in the ground, and afterwards moved in another direction, nearly at right angles to the former, leaving a similar indication of the course in which it had moved. Intermediately between the time when the tornado bore in those directions, the frame was protected by a house.

While the phenomena above described sufficiently indicate the existence of a horizontal conflux of the air, that of a vertical force was demonstrated by the transportation of the debris of the houses and trees, as well as lighter bodies, to a great distance. A lady's reticule was carried seven miles from New Brunswick, and a letter twenty miles. The piece of timber, technically called the plate, on which the rafters of the roof of a church in New Brunswick rested, was carried nearly a quarter of a mile, and lodged in some trees beyond the Raritan. The fields, on the other side of that river, were strewed with shingles torn from the houses in the town.

After maturely considering all the facts, I am led to suggest that a tornado is the effect of an electrified current of air, superseding the more usual means of discharge between the earth and clouds in those sparks or flashes which are called lightning. I conceive that the inevitable effect of such a current would be to counteract within its sphere the pressure of the atmosphere, and thus enable this fluid, in obedience to its elasticity, to rush into the rarer medium above.

It will, I believe, be admitted, that whenever there is sufficient electricity generated to afford a succession of sparks, the quantity must be sufficient, under favorable circumstances, to be productive of an electrical current; and that light bodies, lying upon one of the electrified surfaces, may be attracted more or less by the other.

The phenomena of the rise and fall of electrified pith balls, called electrical hail, sufficiently justify this last mentioned statement; while the continuous stream is illustrated by the electrical brush, or the blast of air produced by a highly electrified point.

It will also be conceded, that thunder and lightning are caused by discharges of electricity between the earth and clouds, analogous to those of a Leyden jar or pane; the air performing the part of an electric in place of the glass, while the cloud acts as a coating.

It follows that the phenomena above mentioned as liable to arise between oppositely electrified bodies, may be expected to take place between the clouds and the earth, with effects as much exceeding those produced by human agency, as the snap and spark of an electric battery are exceeded by thunder and lightning. If in the one case pith balls and other light bodies are lifted; in the other, water, trees, houses, hay-stacks and barns may be powerfully affected.* If from a point electrified by a human contrivance, a blast of air is induced; it is assuredly not unreasonable to ascribe to the analogous electrical apparatus of nature, aided by the elasticity of the air, a vertical hurricane. It was under the well founded impression that lightning may be superseded by a current, that we have been instructed by Franklin, to surmount our lightning rods by metallic points, by which electrical discharges from thunder clouds are expected to be conveyed to the earth gradually, which might otherwise pass in sparks of lightning of a formidable magnitude.

If, then, it be demonstrated that a continuous discharge of electricity may become the substitute for lightning, and that within the sphere of the discharge the air may be so lifted as to counteract its

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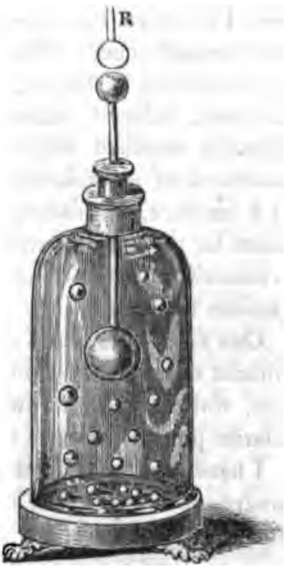

* This figure affords an illustration in miniature of the rise and fall of bodies situated between oppositely electrified surfaces, which, in the gigantic operations of nature, are conceived to be the exciting cause of the tornado. The phenomena represented by it are designated in Pixii's catalogue as "grelé electrique," and may be thus explained. A metallic rod supports one ball within the bell glass, another without, so as to be in contact with the knob of another rod R, proceeding from the conductor of an electrical machine in operation. The brass ball being by these means intensely electrified, attracts some of the pith balls which lie upon the metallic dish in which the bell is situated, and which should communicate with the cushions of the machine. As soon as the pith balls come into contact with the electrified ball, becoming similarly excited, agreeably to the general law they recede from each other and are attracted by the oppositely electrified dish. Reaching the dish, they attain the same electrical state as at first, and are, of course, liable to be attracted again.

gravity; it is in the next place only necessary to advert to facts perfectly well known, in order to point out a cause of acceleration sufficient to account for the well known violence of the tornado.

At the height of fifteen miles, the air has been ascertained to have less than one thirtieth of the density of the stratum next the earth. Of course this substratum would exercise a force nearly equal to the atmospheric pressure, or about fourteen and a half pounds to the square inch, in order to attain the space occupied by the rare medium, to which allusion has been made. It follows that if the weight of the superincumbent air were removed or counteracted, that the inferior stratum would rise with explosive violence.

While the air is thus carried upwards by the concurrent influence of electrical attraction, and the reaction of its own previously constrained elasticity, other bodies are lifted, both by electrical attraction, and the blast of air to which it gives rise. Hence houses within the sphere of the excitement are burst by the expansion of the air which they contain, their walls being thrown outwards, and their roofs carried away; while, by the afflux of the atmosphere requisite to the restoration of its equilibrium, trees, houses, and other bodies are thrown inwards towards the vertical current, from before, as well as from either side.

When once a vertical current is established, and a vortex produced, I conceive that it may continue after the exciting cause may have ceased to act. The effect of a vortex in protecting the space about which it is formed, from the pressure of the fluid in which it has been induced, must be familiar to every observer. In fact, Franklin ascribed the water spout to a whirlwind produced by the concourse of the atmosphere to a given point. His hypothesis was, as I conceive, unsatisfactory, because it did not assign any adequate cause for the concentration of the wind, or for the hiatus which was presumed to be the cause. This deficiency is supplied, if my suggestions be correct.

One fact, of which I am myself a witness, cannot be explained without supposing a gyratory force. About six feet of a brick chimney, without being thrown down, were so twisted on the remaining inferior portion, as to be left with its corners projecting.

I have hardly deemed it necessary to advert to the cause of the progressive motion of a tornado, since that would appear evidently due to the current of the atmosphere within which it may be created.

I believe that the electrical excitement which gives rise to atmospheric discharges of electricity, in whatever form they may occur, is usually ascribed to the chemical changes taking place in the atmosphere; especially the formation or condensation of vapor.

Another view of this subject has suggested itself to my mind. It is known that the atmosphere acts generally as an electric, while the earth acts as a conductor of electricity; and since the electric fluid passes through an exhausted receiver with great facility, it results that the rare medium which exists at a great elevation, is equivalent to another conductor. Hence it is evident that there are three enormous concentric spaces, of which that which is intermediate contains an electric, to which the others may act as coatings. When the tendency of the electric fluid to preserve an equilibrium is taken into view, I believe myself justified in the inference, that not only the space occupied by the globe, but the region beyond our atmosphere, or where the air is sufficiently rare to act as a conductor, must abound with electricity. Thus the atmosphere is situated between two oceans of electricity, of which the tension may often be different. Between these electric oceans, the clouds, floating in the non-conducting air, must act as movable insulated conductors; and from the excitement consequent upon induction, chemical changes, or their proximity to the celestial electric ocean, must be liable to be electrified differently from each other, and from the terrestrial electric ocean.

The phenomena of thunder storms may arise, from the passage of electricity from one electric ocean to the other being facilitated by an intervening accumulation of the clouds, or in consequence of discharges from one insulated congeries of clouds to another through the earth.

The aurora borealis may arise from discharges from one ocean to the other of electricity, which, not being concentrated by its attraction for intervening clouds within air sufficiently dense to act as an electric, assumes the diffuse form which characterizes that phenomenon.

Falling stars may consist of electric matter, in transitu between one portion of the celestial electric ocean and another, tending to restore the equilibrium when disturbed. They may, in fact, consist of electric matter, passing from one mass of moisture to another; as it may be imagined that in an expanse so vast, in which the tension is so low, there may be a great diversity as respects the quantity of moisture existing in different parts. Indeed, it may be conceived that at times the clouds, insulated from each other, may make their reciprocal discharges through the region occupied by the celestial ocean.

I have been informed by my intelligent friend, Mr. Quinby, who resided for some time in Peru, at an elevation of fifteen thousand feet above the level of the ocean, that the clouds in that elevated region are far more electric than in the lower country of the same latitude; and that, on this account, it was considered as dangerous, at times, to travel in the "*sierras*," or table land. Possibly thunder storms are more frequent in warm weather, in consequence of the greater elevation which the clouds then attain, and their consequent approximation to the celestial ocean of electricity.

Consistently with the hypothesis which I suggested in my essay on the gales of the United States, the enduring rains which accompany those gales are attributed to the contact of an upper warm and moist current of air, with a lower current of the same fluid at an inferior temperature, and moving in an opposite direction. It would follow that, on such occasions, the electricity of the upper region would be diffused among the clouds within the upper stratum, without reaching those existing within the lower current. But in such cases neither stratum would be sufficiently insulated and restricted in its extent to transmit the electricity in a concentrated form, or to be liable to the intense excitement necessary to produce a tornado or lightning.

Facts and Observations respecting the Tornado which occurred at New Brunswick, N. J., in June last, abstracted from a written statement made by James P. Espy, M. A. P. S.; by R. Hare, M. D. &c. &c.

The tornado was formed about seven and a half miles west of New Brunswick, and, moving at the rate of about twenty five or thirty miles in an hour, terminated suddenly at Amboy, about seventeen and a half miles from the place of its commencement. It appeared like an inverted cone, of which the base was in the clouds, and the vertex upon the earth. It prostrated or carried off every movable body within its path; which was from two hundred to four hundred yards wide. Trees which were embraced successively within its axis were thrown down in a direction parallel to its path; those on either side always pointing towards some point which had been under its axis. Houses were unroofed, and, in some instances, unfloored; in others, their walls were thrown down outwards, as if burst by an explosion. There are two facts stated by Mr. Espy, and confirmed by Prof. Bache, which demonstrate fully the existence of an hiatus. In a house which was exposed to the vertical influence of the tornado, a sheet was lifted from a bed, and carried into a fissure made in the southern wall, which subsequently closed and retained it. The same result was observed in the case of a handkerchief, similarly fastened into a fissure in the northern wall. In some instances, frame buildings were lifted entire from their foundations. Joists and rafters were torn from a house and thrown down at the distance from it of about four hundred yards, and in a direction opposite to that in which the trees not lifted from the earth's surface were prostrated. Of course lighter bodies, such as shingles, hats, books and papers, and branches and leaves of trees, were carried to much greater distances. There was no general rain, but hail and rain accompanied the fall of the other bodies. The tornado lasted, in any one place, for but a few seconds: the whole of the damage done at a farm having been accomplished, as the farmer stated, while he was passing from the front to the rear of his mansion, so that, by the time that he reached the back door, there was a perfect calm. Meanwhile, his house and barn were unroofed, and all the neighboring trees thrown down. The noise which accompanied the phenomenon was by every witness described as terrific, being best exemplified by the rumbling of an immense number of heavy carriages. Every object in its path was bespattered with mud on the side towards that from which it advanced. Houses looked as if roughcast, and individuals were so covered with dirt as to be disguised.

Some thunder and lightning attended the tornado. Some trees, which resisted the onset, yielded subsequently; and hence were piled upon those which had fallen earlier. The weaker trees were undermost, and pointed in the direction in which the tornado approached; while the stronger were on the top, pointing in the direction in which it moved away.

Four different places were noticed, where all the trees lay, with their summits directed to a common center. In the middle of one of these localities, the house was unroofed, and the handkerchief and sheet were lodged within the fissures in the walls, as already stated. The windows in the same house were all broken, and much of the glass thrown outside. From the evidence, Mr. Espy infers that the apparent height of the tornado was about a mile. He states that there were, on the same day, two other tornadoes, about seventeen miles apart; and of which the nearest was about the same distance from that of New Brunswick. He conceives that the phenomena all concurred to demonstrate an "inward motion from all directions towards the center of the tornado, and an upward motion in the middle." These statements of Mr. Espy are confirmed by Prof. Bache.

One fact of some importance has not been mentioned by Mr. Espy, which was observed by persons who were upon the ground, during or soon after the catastrophe. I allude to the partial withering of the foliage of those small trees or shrubs which, from their suppleness, were like the reed in the fable, neither uprooted nor overthrown. This unpleasant effect was perceptible when I visited the scene. Each leaf was only partially withered. As it would be inconceivable that mechanical laceration could have thus extended itself equably among the foliage, a surmise may be warranted that the change was effected by the electricity associated with the tornado.

Concluding Remarks, by the Author of the Article.

I ought, perhaps, sooner to have acknowledged that I am aware that it has often been suggested that water spouts might be caused by electricity; but the conjecture has not, so far as my information goes, been heretofore supported by any satisfactory explanation as to the mode in which such a tremendous power could arise from that source. That I am warranted in this impression, will, I trust, appear evident from the circumstance that two of the most distinguished among the late writers in the department of science to which the subject belongs, seem to admit, or to demonstrate, their inability to afford any explanation. I allude to Pouillet and Despretz.

In his treatise on meteorology, Pouillet introduces two narratives respecting tornadoes, which were analogous in every essential point to that of New Brunswick. Especially the existence of an hiatus is proved by the allegation that the walls of prostrated houses were thrown down outwards. A laborer was first urged forwards, in the next place lifted, and lastly overthrown.

The learned and ingenious author concludes with these remarks. "Comment cette puissance, quelquefois si prodigieuse, peut-elle prendre naissance au milieu des airs? C'est une question, il faut de dire, à laquelle la science ne peut faire aucune réponse précise. De toutes les conjectures vagues et hasardées, que l'on peut faire sur l'origine de ce météore, la moins invraisemblable est peut-être celle que le regarde comme un tourbillon d'une excessive intensité. Mais une discussion sur ce point nous semblerait prématurée; il faut multiplier les observations, et constater avec plus de précision toutes les circonstances de ces phénoménes."*

All the information respecting tornadoes afforded by Despretz is comprised in the following paragraphs, which I quote in his own words.

"*Trombe.* La trombe se montre en mer et sur la terre; tantôt elle semble sortir du sein de la mer, et s'élève jusqu'aux nuages; tantôt elle descend des nuages jusqu'à terre.

"C'est une colonne d'eau cônique qui tourne sur elle-même avec une grande vitesse; elle a quelquefois jusqu'à plus de deux cents métres de base. Elle est très-commune entre les tropiques: les navigateurs passent rarement près des côtes de Guinée sans en apercevoir plusieurs.

"Les trombes produisent des effets terribles; elles déracinent les arbres, renversent les faibles habitations, soulèvent les voitures, etc.

"On peut se faire une idée des trombes par les tourbillons de poussiére qui se forment tout à-coup, en été, sur les routes, et qui tournent sur eux-mêmes avec une grande rapidité."†

In Nicholson's Journal, quarto series, London, 1797, vol. 1, page 583, there is an interesting account of some tornadoes seen from Nice, illustrated by engravings, by M. Michaud, who appears to consider them as the effect of electricity, and infers that he could produce the phenomenon in miniature by the aid of a machine, as thunder and lightning are by the same means illustrated. This I have found to be erroneous, as far as my experience goes, and from a cause which is, agreeably to my hypothesis, quite evident. I mean the absence of the co-operating influence of the air when emancipated by electric attraction from the confinement arising from its own weight.

The theoretic remarks of Michaud are very brief, and, to me, scarcely intelligible, as he does not inform us in what way he supposes the electric fluid to operate.

I have understood, since I conceived my hypothesis, that Beccaria ascribed water spouts to electricity, but I have not had the advantage of learning by what reasoning he justified his inferences. However, should it appear that I have made, through the want of information, any undue claim to priority, I shall cheerfully do justice to any philosopher whose speculations I may have overlooked.

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* Elemens de Physique Experimentale et de Météorologie, vol. 2, p. 727.

† Traité Elementaire de Physique, paragraph 656, p. 828, par C. Despretz.

Art. XVI.—*Description of Edwardsite, a New Mineral;* by Charles Upham Shepard, M. D., Prof. of Chem. in the Medical College of the State of South Carolina.

Mineralogical description.—Primary form. Oblique rhombic prism. M on M=95° (common goniometer.) Base oblique from an obtuse edge.

Secondary form. The primary, with the acute lateral edges replaced by single planes inclining to the adjacent lateral faces under 137° 30′ common goniometer.) In very minute crystals, the summits are occasionally surmounted by four-sided pyramids whose faces correspond to the lateral edges of the prism.

Cleavage parallel to the bases sometimes distinct, but more commonly uneven: in the direction of the longer diagonal very perfect. Surface generally not very smooth, but nearly of the same quality on the different faces.

Lustre vitreous to adamantine. Color hyacinth-red. Streak white. Transparent to translucent.

Hardness=4.5. Sp. gr.=4.2 . . . 4.6.

Chemical description.—Alone before the blowpipe, in very thin fragments, it loses its red color, becoming pearl grey with a tinge of yellow, and fuses with great difficulty on the edges into a transparent glass. With borax, in little fragments, it turns white and gradually dissolves, forming a globule which is bright yellowish green while warm, but colorless when cold. When powdered, it is acted upon very slightly, by aqua regia. A small quantity placed on platinum foil and moistened with sulphuric acid, tinged the flame of the blowpipe green.

General observations.—The crystals are rarely above one third of an inch in length by one sixth in breadth. The replacement of the acute lateral edges is deep, imparting to the prism a flattened appearance, except in the case of very minute crystals surmounted by pyramids; these scarcely exhibit any alteration of the primary prism. The terminations of the larger crystals are always incomplete. In some of them, however, the cross cleavage is eminent, in which instances the lateral faces exhibit cross striæ parallel with this cleavage, analogous to certain varieties of Hornblende and Pyroxene. The nearest approximations to the value of the angle of inclination between the base and the prism was 100° for P on M. More perfect crystals, however, are needed than any I have yet seen for deducing the incidence of P to the obtuse lateral edge. The diagonal cleavage is almost as perfect as the corresponding cleavage in Sillimanite. So close is the resemblance between the smaller crystals above alluded to and Zircon, that on first inspection I mistook them for that species.

The Edwardsite occurs disseminated through Bucholzite in gneiss at the falls of the Yantic in Norwich, Connecticut. The Bucholzite is here considerably abundant, forming apparently a small bed through which are dispersed also individuals of red feldspar, black mica, and more rarely small crystals of blue corundum. The variety of Bucholzite is intermediate in the size of its fibres between that of Chester, Conn. (the Sillimanite,) and that found at Chester, near Philadelphia, and denominated Fibrolite.

Having discovered the mineral above described, while occupied along with my colleague, Dr. PERCIVAL, in the geological examination of the state, I have thought proper to name it in honor of his excellency Henry W. Edwards, the governor of the state; since the survey was first recommended by his Excellency, and is still in progress under his administration. Its place in the natural arrangement of minerals is obviously within the genus Tungstic Baryte, and its systematic name as hence arising, and connected also with its system of crystallization, will be the *Hemi-prismatic Tungstic Baryte.*

ANALYSES.

Qualitative examination.—28 centigrammes of the mineral, in the state of an impalpable powder, were heated to whiteness in a platina crucible, whereby it lost 1.5 centigrammes in weight. Another portion was treated with sulphuric acid in a glass tube, without occasioning any perceptible corrosion of the glass.

The mineral was next examined for phosphoric acid, of the presence of which a strong indication was mentioned in the chemical description of the species above given. 11 centigrammes of the ignited mineral were mingled with thrice its weight of carbonate of potassa and heated in a platinum crucible for fifteen minutes. The mixture swelled up, became grayish white, porous, and suffered imperfect fusion. Dilute acetic acid was added to the mass: a copious, heavy, reddish white powder remained undissolved. To the clear acetic solution, acetate of lead was added, which occasioned a dense white precipitate. Nitrate of silver produced a copious yellow precipitate in the same solution. A portion of the white precipitate was heated on platinum foil before the blowpipe; it easily suffered fusion, and on cooling crystallized in the form of an irregular dodecahedron. The mineral was accordingly inferred to be a phosphate.

The matter undissolved by the acetic acid was digested for some time with hydrochloric acid. An odor of chlorine was evolved, attended with a very slow solution of the substance, circumstances which, taken along with the color it assumed, led me to suspect the presence of cerium. A portion of the clear solution was withdrawn and evaporated to dryness, after which water was affused and ammonia added. The precipitate occasioned after washing, was digested in oxalic acid, and the solution separated from the undissolved portion. The latter on being ignited and crushed to powder had a tile red color, and was inferred to be nearly pure peroxide of cerium. The solution gave on the addition of hydrosulphate of ammonia a faint black precipitate, which was taken for sulphuret of iron. Another portion of the hydrochloric solution, containing crystals of sulphate of potassa, was set aside for twenty four hours, when a fine white grained deposit had formed on the bottom of the vessel. This deposit was separated, dissolved in hot water, and decomposed by soda. The precipitate was washed and ignited. It had a tile red color, and was regarded as peroxide of cerium, either pure or only mixed with a little zirconia. The solution from which the crystals had been precipitated was tested for yttria by ammonia, but no cloudiness in the fluid was perceived.

Being satisfied by the foregoing experiments that the mineral was essentially a phosphate of cerium, I did not, on account of the scarcity of the substance, carry my examinations any farther previous to entering upon the analysis.

Quantitative examination.—A. 45 centigrammes of the mineral were mingled with two grammes of carbonate of soda, and heated in a platinum crucible nearly to whiteness for an hour. The matter suffered complete fusion, having shrunk into a very compact mass, with a radiating structure and a grayish white color, with occasional tinges of yellow.

B. Water was repeatedly boiled upon the mass, until the whole was removed from the crucible. The alkaline solution was separated from the insoluble matter by means of the filter, and saturated with acetic acid.

C. The acetic solution (B) was evaporated to dryness and water affused whereby flocculi of silicic acid appeared in the solution, which were separated by a double filter, washed, ignited and weighed 0.25 centigramme.

D. The filtered solution (C) was treated with acetate of lead so long as any precipitate went down. The precipitate was separated, washed, and heated to redness. It weighed 68 centigrammes, which consisting of the subsesquiphosphate of lead, is equivalent to 12 centigrammes of phosphoric acid.

E. The undissolved matter from the alkaline solution B, which had a yellowish white color, was digested in hydrochloric acid for several hours, during which chlorine was emitted and the matter which was not taken up changed from yellow to reddish brown. The solution was withdrawn from the undissolved portion and precipitated by potassa with ebullition. The precipitate had a bluish gray color. When washed and ignited, it weighed 15 centigrammes, and had a chestnut brown color.

F. The alkaline solution (E) was rendered slightly acid by means of hydrochloric acid, after which ammonia was added; a white flocculent precipitate appeared. It was separated from the solution by the filter, and after washing was treated with hydrochloric acid, whereby about two thirds of its bulk were dissolved; the remainder was silicic acid. The solution was transferred to a flask and digested for several hours, with excess of carbonate of ammonia, in a mild temperature. That portion of the precipitate which was not taken up by the ammoniacal solution, was separated, washed, and estimated by means of the double filter at 2 centigrammes.

G. The ammoniacal solution from which the alumina was separated (E) being boiled for a few minutes, became milky; but after being evaporated to dryness and ignited in a platinum capsule, the residuum of glucina was too small to be appreciated by the balance.

H. The solution from which the alumina and glucina had been precipitated by ammonia (F) was tested for lime by the addition of oxalate of ammonia. No cloudiness was occasioned by the oxalate. After some hours standing, the solution was treated with phosphate of soda, whereby its transparency was slightly affected.

I. The 15 centigrammes of a chestnut brown powder (E) were digested for some time in hydrochloric acid and finally treated with sulphuric acid. The matter remaining undissolved was separated, washed, and ignited. It weighed 3.5 centigrammes and had the appearance of pure peroxide of cerium. To the acid solution at a boiling temperature, sulphate of potassa was added, and immediately afterwards a little ammonia, but not sufficient to supersaturate the free acid. A fine white grained precipitate instantly appeared, which was taken for subsulphate of zirconia. It was separated, re-dissolved, and precipitated by potassa. The solution from which the subsulphate was separated was then thrown down by potassa, and the precipitate after edulcoration and ignition weighed 8 centigrammes. It possessed moreover the properties of pure peroxide of cerium. We have therefore 11.5 centigrammes peroxide of cerium in the 15 centigrammes, leaving 3.5 centigrammes for the zirconia: and regarding the undissolved reddish brown matter E as peroxide of cerium, which it closely resembled after ignition, the total weight of this oxide from 45 centigrammes of the mineral is 27.4 centigrammes, or 24.53 centigrammes of the protoxide, in which state of oxidation the cerium no doubt exists in the mineral.

The following, therefore, is a summary of the results obtained in this analysis.

	Centigrammes.			
Protoxide of cerium, .	25.44	or	56.53	p. c.
Phosphoric acid, . .	12.00	"	26.66	"
Zirconia, ...	3.50	"	7.77	"
Alumina, ...	2.00	"	4.44	"
Silicic acid, . . .	1.50	"	3.33	"
	44.44		98.73	
Protoxide of iron,	a trace.			
Glucina,	"			
Magnesia,	"			

The phosphoric acid and oxide of cerium are almost exactly in the ratio of one atom of the former to one and a half of the latter. The Edwardsite is therefore a *basic sesquiphosphate of the protoxide of cerium.* In what manner the other ingredients are combined, or whether they are merely accidental, I shall not venture to decide without an opportunity of confirming the proportions here stated by a repetition of the analysis on a larger quantity of the mineral.

Charleston, S. C. January 30th, 1837.

ART. XVII.—*Description of a new Trilobite*; by JACOB GREEN, M. D., Professor of Chemistry in Jefferson Medical College, Philadelphia.

CALYMENE PHLYCTAINODES.*—*Green.*

Clypeo semilunari, lobis inflatis valdè punctulatis, anticè rotundatoco; cauda ——?

I HAVE been for a long time expecting to find among the trilobites of North America, a species analogous to the *C. variolaris*, which is sometimes met with among the fossils at Dudley in England. Its association with the *C. Blumenbachii* at that locality, and the occurrence of that species in such numbers in the transition limestone so extensively spread over the United States, induced the belief that it would sooner or later be discovered in our rocks.

Dr. William Blanding of this city, has recently received from Springfield (Ohio,) a number of very perfect specimens of the *C. Blumenbachii* and other fossils. In this rich parcel I had the pleasure of discovering a fine fragment of the buckler, of a species not very unlike the *C. variolaris* of Professor Brongniart,—Plate I, fig. 3, A,—the original of which came from Dudley, and is said to be now in the collection of Mr. Johnson, of Bristol, (Eng.)

Nearly the whole of the buckler of our species is perfect, in the specimen I have examined. The middle lobe is large, and very prominent: there are no folds or tubercles upon it, as in the *C. Blumenbachii*, or the *C. macrophthalma*, but the whole of its surface, as well as that of the cheeks, is covered with distinct, rounded grains, or warty pustules. The *C. variolaris* is also furnished with a similar structure, but Prof. Brongniart states that the pustulations in that species, are all pierced at their summit with a small hole, like the tubercles on the genus *Cidaris* among the Echini: this is not the case in our species, the tubercles being all imperforate; they resemble exactly in this respect those on the shell of the *Echinus mammillaris* of Lamarck. The whole contour of the cheeks or side lobes of the buckler, cannot be made out from our fragment; they no doubt, however, form spherical triangles; each cheek is divided by a deep groove into two lobes; the portion of the lobe nearest the front is rounded and mammillary; the anterior lateral margin of the other lobe on each cheek is lost, but the rest is very perfect. The edge nearest the abdomen runs parallel with the articulations of the vertebral column, and from its inner edge the front of the buckler starts up in high relief. Between the front and the articulations of the back it is quite narrow, but it swells up and enlarges as it proceeds laterally, so as to give to the whole buckler a pentelobate appearance. In the *C. variolaris* the external angles of the buckler have a prolongation down the sides of the abdomen to the sixth articulation: our mutilated fragment will not permit a comparison in this particular, as one articulation of the back is all that remains. There is no appearance of eyes, though there can be but little doubt that these organs will yet be discovered in other specimens. The breadth of the buckler is one inch and a half; and the length, measuring over the front, is the same.

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* Phlyctainodes—from the Greek, for *pustulated.*

For this highly interesting species, I am indebted to the kindness of Dr. William Blanding, whose indefatigable labors have greatly contributed to illustrate several departments of American natural history. In a note from that gentleman, which accompanied our fossil, he remarks, "It was obtained from the limestone used in constructing the national road, the quarry of which is within two miles of Springfield, Ohio." The limestone is of a light gray color, and the fossil is spangled with little crystalline particles of that mineral.

In Parkinson's Organic Remains, vol. iii. plate 17, figure 16, there is a representation of the anterior portion of the *C. variolaris*, to which Professor Brongniart refers. The following short account of it is given at p. 266, which will enable those who are curious, to compare our species with it. "In this animal, the lobular divisions seem to have very nearly corresponded with those of the Dudley species; but the structure of the head part differs exceedingly from every other species. In this fossil, instead of the appearance of the distinct parts of a face, there are three large round protuberances, the middle being the largest, and all these protuberances are closely beset with small tubercular elevations. These protuberances occupy nearly the whole space of the head, the eyes being placed on the centre of each of the lateral elevations. The matrix of this is a fine white limestone, but I am not able to say where it was obtained."

ASAPHUS PLATYPLEURUS.—*Green.*

Clypeo ? corpore convexo; costis latis, planissimis; parte marginali vix membranacea; cauda rotundata.

I have seen the lower portions only of this trilobite, but the characters which they present are sufficiently striking and peculiar to distinguish it from the other species. Ten articulations of the caudal extremity of the animal still remain in a good state of preservation. The middle lobe of the back is scarcely elevated above the plane of the lateral lobes, and as often occurs in the Asaphs; it has a regular conical appearance, the apex of the cone forming the terminal joint of the tail. Two or three of the last articulations in our specimen are somewhat obliterated. The ribs both of the sides and of the middle lobe are broad and very much flattened; their upper surface is entirely smooth, except a slight sulcus near the lower edge of the costal arches. The grooves or furrows formed by the joints are narrow and not very deep. The tail is rounded, and the membranaceous expansion or border which is found in most of the Asaphs, is in this species but very little developed. In one side it is mutilated in our fragment. The body of the animal projects considerably above the rock in which it is imbedded, and is therefore very unlike the depressed forms of most of the Asaphs; indeed, at first sight I took it for a Calymene.

The rock in which the A. Platypleurus is mineralized, is composed of hard, compact, black limestone. A small fragment of another Asaph reposes near the one just described. It may perhaps be the remains of the young of that species, though the ribs are much more rounded. There is also the joint of a small encrinite adhering to one of the costal arches.

I am indebted to my young friend, Dr. R. M. Jackson, for this and some other trilobites found by him in Huntington County, Penn.

MISCELLANIES.

DOMESTIC AND FOREIGN.

1. *Mr. Faraday on the most improved form of the Galvanic Deflagrator, especially as constructed by Dr. Hare.*—More than sixteen years have elapsed since an account was given in this Journal by Dr. Hare of his galvanic deflagrators, and of their great power in proportion to their size in producing intense ignition. Not long after, the experiments of Dr. Hare were with some additions repeated by us, and the results fully confirming the allegations of the inventor were also published in this work. Although Dr. Hare's memoirs and ours with engravings were published in the Annals of Philosophy and Philosophical Magazine, London, yet it does not appear that his deflagrators were imitated in Europe, the old and inferior constructions continuing in general use. It is satisfactory to find from the following abstracts from a paper of Mr. Faraday, that the course of his investigations has led him latterly to consider the deflagrator of our countryman as the most efficient form of a galvanic series. We quote those passages of Mr. Faraday's paper on the subject of the deflagrator which tend to justify our statement.

Alluding to the principles which this distinguished author had considered as established by his investigations, he uses the following language.

"Guided by these principles, I was led to the construction of a voltaic trough in which the coppers passing round both surfaces of the zincs as in Wollaston's construction should not be separated from each other except by an intervening thickness of paper, or in some other way so as to prevent metallic contact, and should thus constitute an instrument compact, powerful, economical, and easy of use. On examining however what had been done before I found that the new trough was in all essential respects the same as that invented and described by Dr. Hare, Professor in the University of Pennsylvania, to whom I have great pleasure in referring it.

"Dr. Hare has fully described his trough.* In it the contiguous copper plates are separated by thin veneers of wood, and the acid is poured on to or off the plates by a quarter revolution of an axis, to which both the trough containing the plates and another trough to collect and hold the liquid are fixed. This arrangement I have found the most convenient of any, and have therefore adopted it."

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* Philosoph. Magazine, 1824, Vol. LXIII. p. 271, or Silliman's Journal, Vol. VII. See also a previous paper by Dr. Hare, Annals of Philosophy, [second series,] 1821, Vol. I. p. 329. Also Phil. Mag. [first series,] Vol. LVII. p. 289, in which he speaks of the non necessity of insulation between the coppers.

Here follows an engraving and description of the deflagrator which the celebrated author constructed agreeably to the principles of Dr. Hare's, after which he proceeds to say—

"Such was the facility afforded by this arrangement, that a trough of forty pairs of plates could be unpacked in five minutes, and re-packed again in half an hour; and the whole series was not more than fifteen inches in length.

"This trough of forty pairs of plates three inches square was compared as to the ignition of a platina wire, the discharge between points of charcoal, the shock on the human frame, &c., with forty pairs of four-inch plates having double coppers, and used in porcelain troughs divided into insulating cells, the strength of the acid employed to excite both being the same. In all these effects the former appeared quite equal to the latter. On comparing a second trough of the new construction containing twenty pairs of four-inch plates with twenty pairs of four-inch plates in porcelain troughs, excited by acids of the same strength; the new trough appeared to surpass the old one in producing these effects, especially in the ignition of wire."

We omit here a detail of the ingenious and accurate experiments on which Mr. Faraday's inferences were founded, our object being in this article to quote his conclusions, rather than his premises; and shall accordingly pass on to those portions of his paper in which the former are communicated.

"When ten pairs of the new arrangement were used, the consumption of zinc at each plate was 6.76 equivalents, or 67.6 for the whole. With ten pairs of the common construction, in a porcelain trough, the zinc oxidized was, upon an average, 15.5 equivalents each plate, or 155 for the entire trough.

"No doubt, therefore, can remain of the equality or even the great superiority of this form of voltaic battery over the best previously in use, namely, that with double coppers, in which the cells are insulated. The insulation of the coppers may therefore be dispensed with; and it is that circumstance which principally permits of such other alterations in the construction of the trough as gives it its practical advantages.

"The advantages of this form of trough are very numerous and great. 1st. It is exceedingly compact, for one hundred pairs of plates need not occupy a trough of more than three feet in length. 2d. By Dr. Hare's plan of making the trough turn upon copper pivots which rest upon copper bearings, the latter afford *fixed* terminations; and these I have found it very convenient to connect with two cups of mercury, fastened in the front of the stand of the instrument. These fixed terminations give the great advantage of arranging an apparatus to be used in connexion with the battery *before* the latter is put into action. 3d. The trough is put into readiness for use in an instant, a single jug of dilute acid being sufficient for the charge of one hundred pairs of four inch plates. 4th. On making the trough pass through a quarter of a revolution, it becomes active, and the great advantage is obtained of procuring for the experiment the effect of the *first contact* of the zinc and acid, which is twice or sometimes even thrice that which the battery can produce a minute or two after. 5th. When the experiment is completed, the acid can be at once poured from between the plates, so that the battery is never left to waste during an unconnected state of its extremities; the acid is not unnecessarily exhausted; the zinc is not uselessly consumed; and, besides avoiding these evils, the charge is mixed and rendered uniform, which produces a great and good result; and, upon proceeding to a second experiment, the important effect of *first contact* is again obtained. 6th. The saving of zinc is very great. It is not merely that, whilst in action, the zinc performs more voltaic duty, but *all* the destruction which takes place with the ordinary forms of battery between the experiments is prevented. This saving is of such extent that I estimate the zinc in the new form of battery to be thrice as effective as that in the ordinary form. 7th. The importance of this saving of metal is not merely that the value of the zinc is saved, but that the battery is much lighter and more manageable; and also that the surfaces of the zinc and copper plates may be brought much nearer to each other when the battery is constructed, and remain so until it is worn out: the latter is a very important advantage. 8th. Again, as, in consequence of the saving, thinner plates will perform the duty of thick ones, rolled zinc may be used; and I have found rolled zinc superior to cast zinc in action; a superiority which I incline to attribute to its greater purity. 9th. Another advantage is obtained in the economy of the acid used, which is proportionate to the diminution of the zinc dissolved. 10th. The acid also is more easily exhausted, and is in such small quantity that there is never any occasion to return an old charge into use. Such old acid, whilst out of use, often dissolves portions of copper from the black flocculi usually mingled with it, which are derived from the zinc; now any portion of copper in solution in the charge does great harm, because, by the *local* action of the acid and zinc, it tends to precipitate upon the latter, and diminish its voltaic efficacy. 11th. By using a due mixture of nitric and sulphuric acid for the charge, no gas is evolved from the troughs; so that a battery of several hundred pairs of plates may, without inconvenience, be close to the experimenter. 12th. If, during a series of experiments, the acid becomes exhausted, it can be withdrawn, and replaced by other acid with the utmost facility; and after the experiments are concluded, the great advantage of easily washing the plates is at command. And it appears to me, that in place of making, under different circumstances, mutual sacrifices of comfort, power, and economy, to obtain a desired end, all are at once obtained by Dr. Hare's form of trough.

"But there are some disadvantages which I have not yet had time to overcome, though I trust they will finally be conquered. One is the extreme difficulty of making a wooden trough constantly water-tight under the alternations of wet and dry to which the voltaic instrument is subject. To remedy this evil, Mr. Newman is now engaged in obtaining porcelain troughs. The other disadvantage is a precipitation of copper on the zinc plates. It appears to me to depend mainly on the circumstance that the papers between the coppers retain acid when the trough is emptied; and that this acid slowly acting on the copper, forms a salt, which gradually mingles with the next charge, and is reduced on the zinc plate by the local action: the power of the whole battery is then reduced. I expect that by using slips of glass to separate the coppers at their edges, their contact can be sufficiently prevented, and the space between them be left so open that the acid of a charge can be poured and washed out, and be so removed from *every part* of the trough when the experiments in which it is used are completed.*

"The actual superiority of the troughs which I have constructed on this plan, I believe to depend, first and principally, on the closer approximation of the zinc and copper surfaces;—in my troughs they are only one tenth of an inch apart;—and, next, on the superior quality of the rolled zinc above the cast zinc used in the construction of the ordinary pile. It cannot be that insulation between the contiguous coppers is a disadvantage, but I do not find that it is any advantage; for when, with both the forty pairs of three-inch plates and the twenty pairs of four-inch plates, I used papers well imbibed with wax,† these being so large that when folded at the edges they wrapped over each other, so as to make cells as insulating as those of the porcelain troughs, still no sensible advantage in the chemical action was obtained.

"As, upon principle, there must be a discharge of part of the electricity from the edges of the zinc and copper plates at the sides of the trough, I should prefer, and intend having, troughs constructed with a plate or plates of crown glass at the sides of the trough: the bottom will need none, though to glaze that and the ends would be no disadvantage. The plates need not be fastened in, but only set in their places; nor need they be in large single pieces."‡

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* Dr. Hare has obviated these difficulties by making one trough to go into another, the whole being cemented while heated by a flambeau of alcohol, so as not only to keep the cement liquid, but also to expel the moisture and air from the pores, which in refrigerating absorb the cement. The cement was made by melting together one part of suet and seven of rosin.

† A single paper thus prepared could insulate the electricity of a trough of forty pairs of plates.

‡ Dr. Hare mentioned in his account of his deflagrator made with copper cases, that he had found a series in which the side edges were exposed deficient of power. He objected to having the cases like those employed by Faraday, open at the sides. His cases were closed at the sides, and open above and below.

2. *Fossil Footsteps in Sandstone and Graywacke;* by Prof. EDWARD HITCHCOCK.

TO THE EDITOR.

Sir—During the last autumn, my attention was excited afresh to the subject of fossil footmarks, in consequence of the discovery of several new localities in the valley of the Connecticut river, both in Massachusetts and Connecticut. I have now found them along that river, a distance of eighty miles, at numerous quarries; and as the result of my recent examinations, I am now prepared to describe fourteen new species—double the number described in my first paper, contained in this Journal for January, 1836. In general they are more distinctly marked upon the rock than those formerly described; and some of them bear in some respects so near a resemblance to the feet of living Saurians, that I have denominated them *Sauroidichnites.* But I have no certain evidence as yet, that any of them were made by four-footed animals, although in respect to two or three species I have strong suspicions that such was the fact. I have sometimes thought they might have been made by Pterodactyles; yet they have in general fewer toes than those described by Cuvier and Buckland.

Within a few weeks past, I have found on the flag-stones in the city of New York, some marks which I suspect were made by the feet of a *didactylous* quadruped, which, like the Marsupialia, moved by leaps. The rock is slaty graywacke, from the banks of the Hudson, between Albany and the Highlands. They are by no means as distinct as the footmarks on the new red sandstone above described; nor do I feel very confident of the correctness of the opinion expressed above; but as I discovered them in several places, both in New York and Brooklyn, and found their appearance similar, I cannot come to any other conclusion at present, than the one just named; although the inference which follows from it, viz. *that quadrupeds existed during the deposition of the graywacke group,* seems too much like a dream not to excite strong doubts as to the correctness of that conclusion.

I had prepared a paper, containing a full account of all the fossil footmarks mentioned above, with numerous drawings, both of these and of the tracks of living birds. Yet I have concluded it will be wiser to delay its publication till I have re-examined some of the localities next summer, should life and health be spared. Yet I take the liberty to subjoin a catalogue of all the species hitherto discovered, according to a more comprehensive arrangement, which further discoveries have rendered necessary. And even the classification which I now propose, will probably require other modifications.

I arrange all the footmarks under the general term

ICHNITES, (ιχνος and λιθος.)

The subdivisions are three.

1. *Tetrapodichnites*, (τετραπους, &c.)

*T. didactylus. On graywacke, New York.

2. *Sauroidichnites*, (σαυρος, ειδος, &c.)

*S. Barrattii. Dedicated to Dr. Joseph Barratt of Middletown, its discoverer. Toes, five.
S. palmatus. (Ornithichnites palmatus of my first paper.)
*S. minitans.
*S. polemarchius, (πολεμαρχειος.)
*S. tenuissimus.

3. *Ornithichnites.*

(1.) *Pachydactyli.*

O. giganteus.
O. tuberosus.
*O. parvulus.
*O. parallelus. (O. tuberosus, α dubius of my first paper.)
*O. divaricatus.
*O. cuneatus. Discovered and named by Dr. Barratt.

(2.) *Leptodactyli.*

O. ingens.
*O. robustus. (O. ingens, α minor of my first paper.)
O. diversus.
    α clarus.
    β platydactylus.
*O. Deanii. Dedicated to Dr. James Dean of Greenfield.
*O. tenuis.
O. minimus.
*O. crassus.
*O. minusculus.
O. tetradactylus.
*O. gracilis.

Those species to which an asterisk is prefixed are new. I have been surprised at the great number of these, and others may suppose me deceived. But I apprehend that I have fallen short of the number of distinct species, rather than exceeded it. Numerous specimens of most of these species are in my collection, which I shall ever be happy to exhibit; and for a reasonable return, I am ready to furnish plaster casts and moulds of my best specimens, colored like the rock, with a few of the specimens in the rocks.

I have given the above summary, chiefly because I have had frequent enquiries on the subject from scientific gentlemen, and because it may be a long time before I shall be prepared to give an account in detail.

3. *Observations on the Aurora Borealis of January 25th,* 1837; by Denison Olmsted, Professor of Natural Philosophy and Astronomy in Yale College.

The 17th of November, 1835, the 22d of April, 1836, and the 25th of January, 1837, have severally been rendered memorable for the occurrence of the Aurora Borealis, in forms and colors more magnificent and splendid, than any others witnessed by the present generation. The first of these has been already noticed in this Journal. (See vol. xxix. p. 388.) It was distinguished for exhibiting, on a grand scale, nearly all the varieties of the anrora ever observed in our climate, including the bank of *auroral vapor* in the North—the *streamers*—the *arches*—the *corona* formed around the magnetic pole of the Dipping Needle—and the *undulations* or Merry Dancers; while the whole were set off by that peculiar display of crimson light, which usually attends the most remarkable displays of the aurora. The second, that of April 22d, was distinguished above all others which I have witnessed for the *auroral waves*. They began to be observed before the end of twilight, and continued nearly all night, following each other with astonishing celerity. My friend Mr. Twining and myself, formed each a separate judgment of the velocity, and agreed in the opinion that the time occupied by a wave in ascending through 45 degrees, was about half a second,—a swifter motion than either had ever observed in nature before. The display of these undulations from half past 11, and onward, was striking beyond conception. Their course was generally upward towards the pole of the dipping needle. The evening of the 8th of May, also, exhibited a well defined bow. The careful observations made at Hartford by Mr. P. W. Ellsworth, when compared with my own, afforded tolerably accurate data for estimating its height. From these it resulted, that its perpendicular elevation above the earth was 160 miles.

The aurora of the 25th of January, was the most magnificent of all. It resembled that of November 17, 1835, in many particulars, but its colors were brighter and more diversified, and its columns arranged with more symmetry around the magnetic pole, supporting a canopy of unrivalled grandeur.

It cannot be doubted, that we are passing through one of those interesting periods when the Aurora Borealis, after having been scarcely visible for many years, returns in unusual frequency and splendor. A number of such epochs are distinctly marked in history, a full and learned account of which, as far down as the year 1731, may be seen in the celebrated work of Mairan, on the Aurora Borealis, which constitutes a separate volume of the Memoirs of the Royal Academy of Sciences at Paris. Under this impression, it is deemed the more important to preserve some permanent record of each remarkable return of the phenomenon. The limits allowed to the present article, however, will permit only a very cursory review of the facts.

The following is a synopsis of the observations made by the writer of this article.

My attention was first attracted to the aurora as early as 6 o'clock, before the twilight was over. At this time, the northern sky exhibited a blush not unlike that of the fairest dawn. This was skirted on the east and west by ill-defined columns of crimson light, which moved slowly from north to south. At 7 o'clock, these began to send up *streamers*, all of which tended, as usual, to a common focus situated a few degrees south and east of the zenith. At ten minutes past 7 o'clock, the *corona* was distinctly formed, embracing the Pleiades, which were nearly at its center, and seemed for a few moments to control its mysterious movements. By the diurnal motion, however, those stars soon moved to the westward; but the common focus, or point of concourse, of all the streamers, held a fixed position in the magnetic meridian, and at or near the pole of the dipping needle, as was the case in the similar exhibition of November, 1835. At three different times during the evening, the corona was dispersed, and as often re-formed; but the position of its center remained nearly invariable with respect to the magnetic meridian. Meanwhile, the twilight of the northern sky had moved slowly southward, its boundary spanning the firmament from west to east in a well defined zone, until it left only a segment of the southern hemisphere, about 30 degrees in altitude. This portion of the heavens, thrown as it was into striking contrast with the illuminated parts of the sky appeared of a dark slate color, and exhibited the interesting spectacle of stars seeming to shine brightly through a stratum of black clouds.

These phenomena played off various interesting evolutions, until fifteen minutes after 10 o'clock;* when suddenly the meteor rallied all its forces. Innumerable spindles, of silvery lustre, darted from the crimson folds of light that hung around the sky, and all pointed towards the common focus; and sheets of a thin vapor of mingled white and red, flowed over these, and wreathed themselves around the same point in wavy folds. A universal stillness reigned; and the ground itself, now covered with snow, which exhibited a delicate rosy tint, contributed to enhance the beauty of the scene. It will be obvious, also, to one that reflects on the position of the principal constellations, at that time, that a large portion of all the brightest of the fixed stars, were assembled on the spot. Sirius and Procyon, Castor and Pollux, Capella and Aldebaran, were arranged around the field in striking array, along with Jupiter and Mars, which chanced to be present on the occasion, and both at the period of their greatest splendor.

So delicate was the auroral covering that the light of the stars was but little obscured by it. The clusters of small stars in the head of Orion, when most enveloped, was still distinctly visible; and the two planets appeared through a dense mass of red vapor with seemingly augmented splendor. Mars, especially, seemed peculiarly in his element. In these various attributes of grandeur and beauty, the present greatly exceeded all former exhibitions of the aurora; but there were wanting the auroral waves, or *Merry Dancers*, which made so conspicuous a figure in the great display of November, 1835.

Although the moon was shining in the east, and but little past the full, yet the distinctness of the auroral lights seemed scarcely impaired by it. This is remarkable: perhaps there is not more than one instance on record, when so splendid an exhibition of the aurora was witnessed in the presence of so full a moon.

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* It appears from the observations made by Prof. Dewey, at Rochester, N.Y., that this return of the aurora was about an hour earlier there than here.

The *Magnetic Needle* was watched attentively by Mr. E. C. Herrick, and was observed to undergo extraordinary fluctuations,—at one time (7h. 41m.) deviating a whole degree westward of its mean position, and at another time, traversing 45 minutes of a degree in two minutes of time. The *Barometer* had previously been subject to uncommon variations. On the night of the 21st, between 11 and 12 o'clock, it stood at 28.70 inches—a depression nearly or quite unexampled at this place. From that time it had risen gradually, and during the aurora, it stood at about 30.1 inches. Its entire range since Dec. 19th, when it was 30.91 has been very remarkable, since its maximum at this place in ordinary years, is rarely above 30.70, and its minimum seldom below 29 inches. Early in the evening of the aurora, the *Thermometer* was at 20° (Fah.) but sunk rapidly, and at 10 o'clock was only 4 degrees above zero, and before morning fell quite to zero.

The *Zodiacal light* was at that time very conspicuous in the southwest, and has continued to the present time, March 7th, considerably brighter than in ordinary years.

From various accounts published in the newspapers, and from numerous private communications obligingly made to the Editor of this Journal, and to the writer, it appears, that this auroral exhibition was seen over a vast extent of country, and preserved, at points very remote from each other, a remarkable uniformity of appearance. Its limits are unknown; but we have already heard of it, in a form of the most imposing grandeur, as far north as Quebec, and other parts of British America to the eastward of that place, and as presenting a spectacle equally rare and beautiful as far south as the Island of Bermuda. Throughout nearly the whole of this wide region, the phenomenon is identified by its crimson light, by its streamers and its arches, by its corona formed in the region of the pole of the dipping needle of each place, and by its return a little after 10 o'clock, after having once nearly faded away.

At *Windsor*, Vermont, the description given by the editors of the Vermont Chronicle, corresponded very nearly to the appearances as exhibited here; but they add, that on the following morning "the mercury stood at THIRTY SIX DEGREES BELOW ZERO,—a more intense cold, by two degrees, than the morning of January 4, 1835, as measured by the same thermometer, with the same exposure." At *Troy*, the same morning, the thermometer was, at 7 o'clock, *fifteen* degrees below zero.

Near *Hartford*, the aurora was observed with much attention by Mr. E. H. Burritt. While his observations corresponded, in general to those made elsewhere, it is somewhat singular that he was able to detect no effect on the magnetic needle. On this point he remarks: "In the early part of my observations, I placed a magnetic needle, of more than common sensibility, in the open air, to test, or rather to *verify*, the magnetic theory of these phenomena. Two assistants and myself watched the needle alternately, for two hours; but without the satisfaction of any evidence that the needle felt, in the slightest measure, the inspiration of the scene. I thought if it had ever betokened any sympathy in the most violent agitation of the Northern Lights, it would now be too manifest to be mistaken. This is the more singular, as the convergent point of all the radii of the aurora, appeared to be not only in the magnetic meridian, but in the elevated pole of the dipping needle produced, viz. 67 degrees from the North pole."

It is remarkable that at a place not more than about thirty miles north of New Haven, the needle should appear to have undergone no fluctuations, while they were so obvious here, as noted in the observations of Mr. Herrick, and were noticed in other places remote from this. Thus, a writer in the *Republican*, a paper published at Annapolis, (Maryland,) observes—"The magnetic needle was very sensibly affected—the needles in all the instruments constantly vibrated in the horizontal arc, and exhibited also, in an unwonted degree, by a vertical motion, the tendency to *dip*. In an excellent compass by Dollond, the needle was drawn down into close contact with the plate. The instrument was then inclined in its position to cause the needle to traverse, and the declination noted at nine o'clock, and compared with the amount the next morning at sunrise. The instrument indicated a difference in declination of *ten degrees!*" The Barometer according to the same writer stood at 30.2 inches, within one tenth of an inch of its height at this place, although Annapolis is distant about three hundred miles.

The accurate descriptions with which several able correspondents have furnished me of the phenomenon, as seen at different places, will afford the means of making some estimate of the height of particular objects; but my limits do not permit me to enter upon it here. Nor can I add at present any thing respecting the *origin* of the Aurora Borealis, except to declare my conviction, that it is not satisfactorily accounted for by any existing theory. In assigning it so hastily to *Electricity*, a quietus was given to all farther attempts at explanation, while yet even the presence of this agent, in any extraordinary degree, has never been proved. *Magnetism* has done more: the auroral vapor is proved to have magnetic properties; but still this fact gives us no information respecting its *origin*. This, I believe, is to be sought for in a source extrinsic to the earth.

4. *Foreign Accounts of the Meteoric Shower of November*, 1836.

In our last number, we published a statement of the observations which had been made in this country, on the Meteoric Shower of November last. We learn that, in consequence of an invitation issued by the French Academy, the same occurrence was extensively observed by the astronomers of Europe, which resulted in a full conviction of the periodical nature of this phenomenon, in accordance with the views of Prof. Olmsted, as expressed in preceding numbers of this Journal. A digest of numerous observations, was laid before the Academy by M. Arago, which was followed by an interesting communication on the same subject by M. Biot. Not having yet received the French journals containing these memoirs, and not having room among our miscellanies for a full notice of them contained in the London Athenæum for January 7, 1837, we restrict ourselves to a few brief extracts.

"I do not conclude from the preceding considerations (adds M. Biot) that the meteors of the 13th of November are certainly caused by the collision and perturbations of the solar nebula with and from the Earth. I neither affirm nor reject this identity; all I have been desirous of showing is, that on the 13th of November the Earth is near the ascending node of the nebula, towards which she directs her course, and soon traverses; that in these circumstances of position and movement, she must certainly act by attraction and collision on the material particles of the nebula, which at that period would be found near the ascending nodes of their orbits, and at an equal distance from the Sun and Earth, or very nearly so, whence would result phenomena coincident in direction and period with the meteoric period of the 13th of November. Lastly, I have remarked, that the usual passage of Mercury and Venus across much more central regions of the nebula, must necessarily have disseminated, and do perhaps still disseminate, innumerable particles into orbits very little inclined to the ecliptic, and directed in all ways; so that the Earth may accidentally meet with them in other points of her course.

"Although these inductions are very evident to myself, and seem to be necessarily derived from the facts, and from the laws of attraction, I only offer them with extreme diffidence, because I know how easy it is to be deceived in such matters by the most probable analogies, which we cannot verify by rigorous calculations. It is scarcely necessary for me to state, that all the circumstances of position, direction, and periodicity, peculiar to the meteors of the 13th of November have been collected and made known by Mr. Olmsted, (of America,) in a very comprehensive and highly interesting work. He attributes this phenomenon to the existence of a great meteoric cloud, circulating round the Sun in an orbit inclined about 7 degrees towards the ecliptic. This is also very nearly the inclination of the solar equator and nebula. In order that this cloud may come in collision with the Earth on the 13th of November, he places it at the same distance from the Sun in its ascending node; but only wishing the collision to take place at this point, he gives it a revolution of six months, in an ellipse, the aphelion of which answers to the node of the 13th of November. This peculiarity, besides being improbable, does not appear to me to be necessary to the hypothesis; for every ellipse sufficiently different from the terrestrial ellipse by its flattened form, or the actual position of its perihelion, would fulfil the same conditions.* Mr. Olmsted, in the addition to his first work, published in 1836, says, that he also thought the phenomenon of 1833 might have some affinity with the zodiacal light; and, as a sign of this connection, he makes the curious remark, that in 1833 the zodiacal light was unusually apparent, much more so than in 1834 or 1835. But he infers, that the meteoric cloud may be precisely this very light, more apparent in November because seen in its aphelion at a lesser distance from the Earth, whilst six months afterwards, about the 10th of May, being come back to the same node, and the Earth being on the other side of the Sun, we see it in opposition at a greater distance, and consequently under a smaller apparent diameter. Now these purely optical variations, which must take place in every position of the Earth, according to the laws of perspective, for a finite body seen from different distances, seem to me to be incompatible with the appearance of the zodiacal light, at different periods of the year, as stated by Domenico Cassini, after a long and unremitted series of observations; but I leave this point of discussion to others, and confine myself to thanking Mr. Olmsted for having so carefully collected and stated the evident elements of so curious a phenomenon. The universal interest which M. Arago has obtained for it by publicatious relative to the voyage of the *Bonite*, will doubtless multiply the characteristic elements of its appearance; and the analogy of these facts, with those which have already occupied M. Valz, of Marseilles, makes us hope, that their affinity with the spots on the Sun, and the possible expansions of the solar nebula, will henceforth be studied with as much skill as correctness."

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* Professor Olmsted does not consider the period of six months as an essential part of his theory, but admits that it may be a year. Thus, in the last number of this Journal, page 394, he observes as follows:—"In the present state of our knowledge on this subject, I regard it as a point open for inquiry, whether it will best accord with all the phenomena of shooting stars, to give to the meteoric body a period of nearly one year, or of half a year."

5. *United States' Gold Mine near Fredericksburgh, Va.*

To those who wish information respecting this valuable mine, the following minutes made on the spot by the editor, (August 30, 1836,) may perhaps be of some use, and the proprietors will, we trust, not consider them obtrusive, since, although they are imperfect, it is believed that they are correct, and may promote the interests of those concerned.

This mine is in Spotsylvania County, twelve miles from Fredericksburgh by the road—fifteen by the river Rappahannock, upon which it lies. The rock is generally a slate, between argillite and mica slate. The new shaft, already sunk down one hundred feet, and to go down one hundred and fifty, is in a very hard rock—almost like a granular quartz, or resembling a siliceous slate, but not so compact; a steam engine is used for draining the mine. *The strata* have a high inclination; on the opposite side of the river they are vertical, and here decline about 30 degrees from the perpendicular. *The surface* of the ground is formed in rounded or rolling hills with large curves and deep valleys watered by streams; still, the country is not mountainous. *The gold vein* is quartz lying between the layers of rock and partaking of its inclination; the thickness of the vein varies from one inch to one foot—two feet, or more; the quartz is compact, but is divided or divisible, like the slate, into rhomboidal fragments.

Condition of the gold.—In metallic spangles and points disseminated in the quartz, often visible to the naked eye; pieces rarely large, and more generally concealed entirely in the quartz.

Other metals.—The sulphuret of iron and of copper, (pyrites,) the sulphuret of zinc, (blende,) the argentiferous sulphuret of lead, (galena)—disseminated, more or less, in the quartz. Probably these sulphurets may be auriferous, as that of iron has been found to be.

* *Quartz vein.*—In clay, opened lately:—the vein is about one foot wide and stands up in the clay like a wall; the decay of the slaty rock has probably formed the clay, while the quartz, being a firmer material, has better withstood the action of time.

Crushing or stamping.—The quartz, with the contained gold, is broken down by vertical stampers moved by steam; or it is crushed by huge iron—shod wheels of wood (Chilian mills) moved by water power.

The amalgamation.—The mercury and the crushed quartz are agitated together in Tyrolese or Hungarian bowls, and the amalgam being decomposed by distillation, the gold is thus obtained and the mercury recovered.

Yield of gold.—In general about one pennyweight of gold to one bushel (100 pounds) of the quartz; the quartz that is in place in the solid rock may not contain quite so much, while that in the quartz standing in the clay affords fully that amount, or more; that is to say, one dollar to the one hundred pounds of quartz.

Product for time.—The greatest yield of this mine is about six hundred dollars per week—the general yield is less.

Pits, tunnels, and adits.—Several. One adit at the depth of forty feet is carried into the side of a hill—one tunnel at the depth of eighty feet—the adit being under the tunnel. Extent of ground four hundred and fifty acres—cost, $150,000, or $333 33 per acre.

Expenditures.—In all $18,000—with an income of $12,000, including land and all: the cost of working is $40 per day.

Number of hands.—Forty to fifty, including ten Cornish miners.

Time of beginning operations.—In 1835.

A communication direct from the President of the United States' Gold Mining Company through Mr. F. Shepherd, informs us, that contemplated operations at this mine are soon to be on a much larger scale; and that already the working force has been trebled for the year 1837.

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* Too late for the present No. we have received a description of the auriferous quartz veins of this mine; it will appear in the next number.

6. *Culpeper Gold Mine, Virginia.*

Since the printing of the notice of this mine, and of the other gold mines in Virginia in the present number of this Journal, we have received authentic information from an authority entitled to full credit, that every appearance about the Culpeper mine is very favorable to good success. The workings have been much extended, and new explorations have taken place, disclosing rich and increasing supplies of gold.

The stamping and amalgamating works are far advanced upon an extended scale; they are now equal to the exigencies of the mine and will be extended with its progress. Large supplies of ore are on hand, and arrangements are made, or are in progress, to furnish a full supply to the powerful machinery prepared for its reduction. The expenses are kept within moderate limits, and there appears good reason to expect a favorable result of the enterprise.

7. *Geological Reports.*

I. *Report of a Geological Reconnaissance, made in* 1835, *from Washington, by Green Bay, and the Wisconsin Territory, to the Coteau de Prairie, an elevated Ridge dividing the Missouri from the St. Peter's River;* by G. W. Featherstonhaugh, Esq. Doc. No. 333, printed by order of the Senate, Washington, 1836, pp. 168, with two large maps and four plates of illustrative sections and diagrams.

The plan of this report is substantially the same with that of the preceding year. The greater part of this report is occupied by an elementary sketch of geology, with occasional elucidations from geological facts in this country.

The geological narrative begins at the city of Washington, and contains a sketch of facts on the line of the Potomac to Cumberland —then by Bedford in Pennsylvania, to Pittsburgh—by the Ohio to the great lakes, and through them to Green Bay, lake Michigan— thence by the Fox River, lake Winnebago, the Wisconsin, &c. to the Mississippi—up that river through lake Pepin to the falls of St. Anthony and St. Peter's river—thence up that river to its source— thence to the Coteau de Prairie, and back to the Mississippi and St. Louis, by the way of Dubuque's Lead Mines.

In this wide range, the author met with many interesting facts, which are presented in an attractive form, and it is obvious that the adventure, much of which was performed in a bark canoe, and protracted until winter came with deep snow, demanded no small share of hardihood and perseverance.

As Lt. W. W. Mather, late of West Point, who, under the same authority, participated fully in this adventure, is not named in the report, we presume we may therefore expect a distinct account from his own pen.

II. *First Report on the Geological Survey of the State of New York;* pp. 212. Albany, February 10, 1837, being document No. 161, published by order of the State government.

This very important document is introduced by a statement by his Exc. Gov. W. L. Marcy, addressed to the Legislature, and explanatory of the plan and progress of the survey. Communications are subjoined from

1. Dr. John Torrey, in the botanical department.
2. Dr. James E. De Kay, in the zoological department.
3. Dr. Lewis C. Beck, in the mineralogical and chemical department.
4. The Report of Lt. W. W. Mather on the Geology of the first district.
5. The Report of Prof. E. Emmons on the Geology of the second district.
6. The Report of Mr. T. A. Conrad on the Geology of the third district.
7. The Report of Prof. Lardner Vanuxem on the Geology of the fourth district.

Dr. Torrey and Dr. De Kay, not having as yet entered into the fullness of their labors, have given only an outline of their departments. Dr. Torrey is—

1. To prepare a catalogue of all the plants of the state, indigenous and cultivated.
2. To prepare an herbarium for constant reference, including seven sets for the scientific and literary institutions of the state.
3. To prepare a cabinet of all the woods, fruits, roots, &c. of the state.
4. To procure drawings of the most important plants—to be engraved or otherwise preserved.
5. To communicate information to the citizens who may inquire on subjects connected with his department.

6. To ascertain the best methods of destroying injurious plants.

7. To embody in the final report the most useful applications of botanical knowledge to agriculture, &c.

8. To prepare a State Flora—in the most intelligible and useful form.

Dr. De Kay states, that from a hasty estimate, it is supposed "that the various forms of animated nature exist in about the following proportions:

Mammalia, - - - - - -	60
Birds, - - - - - -	275
Reptiles and Fishes, - - - -	250
Mollusca, - - - - - -	200
Insects, - - - - - -	3,000"

The preliminary reports of the state geologists now printed, have a primary reference to those facts that are of practical utility—the more full scientific views being reserved for the final reports.

Dr. Beck's report on mineralogy and chemical analysis presents the ores of iron as forming a primary—probably *the* primary mineral interest of the state. They are numerous, both in kind and locality, and the annexed analyses shew them to be rich: their actual exploration and manufacture is already great, but being still only in infancy, vast results may hereafter be anticipated.

There are valuable deposits of lead, with ores of zinc; for details we have no room. This department is ably sustained.

Lt. Mather, assisted by Mr. C. Briggs, Jr. reports on the first geological district, including Long and Staten Islands, and all south of the head of Lake Champlain, southwest to the Delaware river, and along the eastern and northern boundaries of Pennsylvania and New Jersey, and the western boundary of the eastern states to the head of Lake Champlain.

Among useful substances—building materials, rocks and clays for brick and pottery, limestones for lime, iron ore, lignite, peat, and shell marl, mineral waters and soils form prominent and important subjects.

The encroachments and changes produced by the sea and the winds along the extensive island-coasts, forming beaches, shoals, spits, &c. and giving rise to land slides, sand, dunes, salt marshes or marsh alluvions, alluvial sandstones, clays, &c. are set forth in an interesting and striking manner, and, along with the erratic blocks, afford fine subjects for theoretical as well as practical geology. We have viewed these scenes with the same interest which they have excited in the minds of the geologists.

Prof. Emmons describes the second geological district, comprising that portion of the state which lies between the St. Lawrence and Lower Canada, and Lake Champlain, down to the great fork of the Hudson, and thence across to the St. Lawrence, thus including the great northwest angle of the state.

Primary rocks are prevalent in this region, with tertiary and transition in certain parts.

The mountains of granite and sienite rise to a great elevation—the highest, *Whiteface*, being nearly five thousand feet above the sea; they form abrupt ridges and defiles, and abound in immense ruins, in vast unbroken forests, in beautiful lakes—often at a high elevation, forming inexhaustible hydraulic fountains, and in metallic ores, especially those of iron. There are mountains of feldspathic rocks, in which the resplendent chatoyant feldspar forms the prevailing mineral. Extensive dykes are numerous here, and the region is highly interesting both in a theoretical and practical view.

A full account is given by Mr. Hall of the iron ores, which are in this region so numerous and rich that their importance, although already realized in many forges, furnaces, and manufactures, cannot be duly estimated for futurity. Prof. Emmons has very properly insisted upon the importance of science in mining, and we fully respond to his views as to the imperious necessity existing in this country for a school of mines, which not only our necessities demand, but our resources now fully justify.

The third geological district comprises the counties east of and contiguous to Lake Ontario, and to its junction with the St. Lawrence—also south of and contiguous to Lake Ontario, pursuing the line of the Erie Canal as far as the counties of Niagara and Erie: this district was assigned to Mr. T. A. Conrad.

The remaining or fourth geological district comprises the remainder of the state, and lies chiefly south of the Erie Canal, extending to the Pennsylvania line south, and west to Lake Erie, the Niagara river and Lake Ontario.

This district was assigned to Prof. Lardner Vanuxem, assisted by Dr. James Eights.

Primary rocks occupy but a small space, comparatively, in the third district, and, excepting stragglers, they are entirely excluded from the fourth.

There are many points of great similarity, and not a few of perfect identity, between these two very important districts. In an agricultural, economical and social view, they are of extreme importance, and not less so are the conclusions so ably and lucidly presented by the gentlemen charged with the examination of these districts.

In passing over them repeatedly in travelling to and fro, in former years, our attention has been arrested by many of the facts set forth by the geologists of these districts; we allude, particularly, to the abundance and antiquity of the organic bodies, and we are forcibly impressed with the momentous importance of the practical, as well as theoretical results to which their observations have conducted them—particularly as regards the geological antiquity of the stratified rocks—the sandstones—the limestone and the slates, depressing them so deep in the series as to preclude the hope of discovering profitable beds of coal in the State of New York, a hope which we believe has never been relinquished. We have no space to display the importance of all the reports and especially of these two districts; they will be attentively studied by American geologists, while they will not neglect to peruse the whole of this valuable document. We are strongly impressed with the vast importance of the geological survey of this State, and with the conviction that it has been confided to able hands. The investigation is one of great responsibility, demanding not only vigor of mind, but extensive knowledge, acquired by the previous expenditure of much time, money and effort. We have therefore from the first, observed, with no small pain, the narrowness of the allotted compensations, still farther diminished by being charged with all personal expenses, and in some cases, they are docked of a few hundreds more, because certain individuals engaged in the survey chanced to have an academic employment, but one not materially interfering with the full discharge of their geological duty.

His excellency the Governor has very properly recommended to the Legislature, the granting of an enlarged compensation—for that now accorded is unworthy the dignity, wealth, intelligence, and high character of the State of New York, and is wholly disproportioned, even in its aggregate, to the vast interests involved; for, the results of this survey will add millions to the resources of this State. Its enlightened Legislature, when they view the whole ground, will doubtless make more ample provision.

These remarks are substantially applicable to other States, not excepting the one where we write, which however possesses not the vast resources of its colossal neighbor. We should not have ventured out of our usual and more appropriate sphere, had we not been long stationed among the watchmen upon the walls of American science, and we are therefore the more unwilling that its merits should be lightly appreciated—unwilling that gentlemen of high character should be left solely or chiefly to motives of patriotism, of benevolence, or of the love of knowledge, for inducements to engage in its more arduous enterprises.

This country is redundant with wealth, increasing beyond calculation; and to this hour, the men who are its pioneers, as regards some of its highest interests, are left with a recompense wholly disproportioned to their talents, their acquirements, their duties, and their responsibility. No men in our country are so inadequately remunerated, except those who have still higher claims—the teachers of religion. On both subjects, the State of New York is well entitled to the honor of leading in a more liberal and righteous career.

III. *Report on the Geological Survey of Ohio, signed by* Dr. S. P. Hildreth, *Chairman*—his associates being *Mr. Riddell, Mr. Lapham, and Dr. Locke.* pp. 187, with diagrams. Columbus, Ohio, 1836.

This report is the result of a reconnaissance of the State of Ohio, under the direction of Dr. Hildreth, whose eminent qualifications for the discharge of this duty have been often made apparent in the pages of this Journal. The prevailing argument with popular legislators, namely, that of utility, in the sense of pecuniary advantage, is fully sustained in this preliminary report. Immense quantities of coal, of iron ore, of limestone, of gypsum, clay, sandstone, marl, and salt are found in Ohio, and in situations exceedingly accessible and favorable for transportation. All this has been abundantly proved by Dr. Hildreth in previous volumes of this Journal; but it was necessary to review the subject and to exhibit it in a lucid and popular form to the legislature and the public. This has been ably done in the report now under consideration, and we cannot doubt that the legislature of Ohio will provide, on a liberal scale, for the expense of the survey, which, however, we must presume, will exceed the estimate of $12,000. It is however easier to obtain additional funds to finish such an undertaking, than it is to obtain an appropriation to begin; and it is not to be presumed that the local government will permit this most important enterprise to fail, or to remain in an unfinished state, especially in the hands of gentlemen of competent knowledge, talent and zeal.

The reports of Mr. Lapham and Dr. Locke, we have not seen, if indeed they have made separate reports. A part of that of Prof. Riddell, but without the illustrations, has come to hand. We have no room for its details, which will in due proportion be embodied in the final report.

IV. *Report on the New Map of Maryland*, 1836. pp. 104, with six large folded maps. In two parts: Part 1, by Prof. J. T. Ducatel. Annapolis, December 26, 1836, on the geology.—Part 2, by J. H. Alexander. Baltimore, February 15, 1837, on the topography and engineering.

The Report of the geologist contains—

Sec. 1. Geological examinations of Calvert county, in reference to its agricultural resources.

Sec. 2. On the present condition of agriculture in Calvert county and the means of improving it.

Sec. 3. Geological examinations made in Ann Arundel county.

Sec. 4. Geological examinations made in St. Mary's, Charles and Prince George's counties.

Sec. 5. Excursion into Allegany county, with preliminary observations on the geology of the country, from the Atlantic tertiary deposits to the bituminous coal region of Frostburg.

Sec. 6. Description of the Frostburg coal-field.

Sec. 7. Description of the maps and sections that accompany the Report.

An introductory view of the geology, &c. of Maryland appeared in this Journal, (Vol. xxvii, p. 1,) and we are happy to see that the outline then sketched, has been so far and so ably filled up by Professor Ducatel, whose own communication on this subject, (which he has encouraged us to expect in a future No.) we will not anticipate by any remarks.

Mr. Alexander's Report on the topography, rail road, and canal capabilities, contains a great amount of exact and valuable information of the greatest importance to the State of Maryland. This Report relates to the Coptank and Transquallin Canal, and to the Atlantic Rail Road.

We trust that the State of Maryland will fully carry out the views of their able engineer, and thus sustain a successful although friendly rivalry with the neighboring states, which are doing so much for the great cause of internal improvement.

V. *Report on the Geological Reconnaissance of the State of Virginia;* by Prof. WM. B. ROGERS, of the University of Virginia. pp. 143; wtth illustrative sections.

This able document, preliminary to a more detailed report, is replete with valuable information, and affords the best assurance of the successful completion of this arduous labor.

Virginia is a fine field for geological observations, as it possesses most of the regular formations that have been found in this country, from the primary to the most recent alluvial. Its tertiary contains inexhaustible resources for agriculture, furnishing the calcareous ingredient of immense deposits of marine shells—while it affords to science many points of interesting comparison with similar deposits in the old world. Its coal fields are rich in the combustible material, and its gold is diffused through a wide region.

It has lead, copper, and iron—sandstone, soapstone, and slates, and mineral waters of great variety, strongly charged with mineral ingredients, and some of them remarkable for an elevated temperature, and for a copious perennial flow. Its great elevated valley of the Shenandoah abounds with ancient fossils, with grand and picturesque scenery, and with modern calcareous deposits in vast caverns. Its natural bridge is one of the wonders of the world. But all appropriate topics will be illustrated in the detailed report—especially "the minute geology, practical and scientific, of all parts of the state.

There will be a geological map, with accompanying sections and profiles, and a cabinet of specimens illustrating the report.

VI. *First Annual Report of* Prof. HENRY D. ROGERS, *of the University of Penn., State Geologist.* Dec 12, 1836. pp. 22.

This Report gives a preliminary reconnaissance of the state, and assigns the groups of formations and their boundaries. The section lying southeast of the Cumberland Valley is denominated the southeast region. The middle area, stretching northeast and southwest, comprising nearly the whole mountainous zone of the state, embraced between the southeast region and the principal ridge of the Allegheny mountains is called by Prof. R. the Appalachian region, while the mountains west are denominated the Allegheny chain. The observations of the late season have been made principally between the Maryland line and the Susquehanna in one direction, and the Cumberland valley and the ridge of the Allegheny mountains in the other, with occasional excursions to the west of the Allegheny on the one hand, and into the Cumberland valley on the other; comprising an area of six thousand square miles.

In the Appalachian region, useful substances abound, although they are limited in number. Coal and iron ore, of several species, are found, and in inexhaustible quantities; limestone, marl, sandstone and conglomerates, also abound. No metal more precious than iron is found in any considerable quantity.

Although the strata are enormously contorted and broken, having evidently been subjected to great violence, there are no igneous rocks—no dykes of trap or porphyry, and no veins of quartz. We are compelled to omit the detailed description of the strata.

It is expected that the survey and all its attendant labors will occupy five years. This luminous preliminary report gives good assurance that the task will be ably performed, and that much good will result—while there is every reason to believe that the State of Pennsylvania will continue to afford all requisite appropriations.

VII. *First Report of the Geology of the State of Maine;* by Charles T. Jackson, M. D., &c. &c., and Geologist to the State of Maine. pp. 128, with an Atlas, containing twenty four plates.

This report came to hand at the last moment of the present number, but exhausted as are both our time and space, we cannot omit to say that it is a performance possessing the highest order of merit. Some years ago, Dr. Jackson and his friend Mr. Alger published in this Journal, (Vols. xiv. and xv.) a memoir on the Geology of Nova Scotia, &c. with a map. This memoir was afterwards, in consequence of another visit to Nova Scotia, revised and enlarged, and published with graphic illustrations in the Transactions of the Boston Academy; for a notice of it see Vol. xxii. p. 167, of this Journal. We there presented this memoir, *as a model* in its kind. It has certainly not been surpassed, by any similar effort in this country before that whose title is given above.

The present sketch of parts of Maine is a masterly production, and is well worthy of an analysis, both on account of the ability with which it is executed, and of the interesting facts which it announces. This analysis is, however, at this time, entirely out of our power, but we cannot dismiss the subject without a few brief remarks.

Maine is a country chiefly of primary rocks—with a large division of those of transition, and towards New Brunswick it has an important region of the lower secondary. Every where it has alluvial and diluvial deposits, and vast igneous formations, not only in the interior but forming a barrier against the ocean surge, along a considerable part of its immense sea coast, indented as it is by bays and estuaries almost beyond example. Among the mineral formations of Maine, are granite, gneiss, mica and talcose, and other slates, including roofing slate and alum slate; also, soapstone, limestone, and marble—sandstones and brecciated rocks of many varieties; jasper, including the beautiful ribbon variety; lead, zinc, manganese and iron;* greenstone, trap and its varieties, and porphyry. The trap dykes are numerous and exceedingly distinct; they cut through most of the other rocks and produce upon them, most distinctly, those peculiar effects, which to a demonstration prove their igneous origin. Scientific geology is greatly indebted to this survey for some of the most lucid and convincing facts on this head; while the diluvial deposits, the boulders and ruins, the diluvial furrows in the rocks, the sea shells now adhering to and inherent in rocks which once formed the sea coast, although elevated twenty six feet above the sea board, a salt spring at Lubec, and many other topics equally illustrate other parts of scientific geology. Dr. Jackson is entirely master of his subject, as well as of the kindred sciences of mineralogy and chemistry, and his report is remarkable for its lucid clearness and its attractive style.

In mentioning (however briefly and imperfectly) the labors of so many able men, we are forcibly struck with the wide contrast between the present state of geological knowledge in our country and that when in our early pursuits in this science, and its congeners—even so late as the first conception of this Journal, (only twenty years ago,) we could hardly find a glimmering taper to enable us to grope our way through the thick darkness. Now if all is not light, certainly light is breaking in from all quarters, and the time is not distant when we shall become acquainted with the geological resources of the whole of this country, and even the entire continent; and already our native geologists have added much to the stores of geological facts, and to the extension and elucidation of the science itself.

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* We have never heard of a case of natural magnetism equal to one named in this report, where a bed of magnetic iron ore not only magnetized so powerfully the iron instruments used to break it up as to adhere to them in large tufts of the fragments of the iron ore, but, a crow bar suspended freely over the iron ore takes the position in the magnetic meridian, and thus becomes a true but gigantic needle.

8. *Fire Bricks.*—Mr. Isaac Doolittle, superintendant of Iron Works at Bennington, Vermont, has, from materials found in that vicinity, manufactured fire bricks, which have stood a blast of five months, and being recently examined appeared so little worn that the furnace has again been put in blast.

This discovery appears of serious importance. We have seen specimens of the sand, which is purely siliceous—of the clay, which is of the porcelain family, and of the brick and a crucible made from these materials, all of which appear to be excellent.

In the furnaces they substitute blocks and bricks formed of these materials for fire stones in the construction of hearths, and of tymps for blast furnaces. Heretofore hearth-stones have been obtained from Stafford, Connecticut, but these materials appear preferable to either for durability and cheapness.

9. *Supposed Volcano at Sea.*—An intelligent shipmaster writes from the coast of California, that on his passage out "on Thursday, April 9, 1835, in lat. 7° N. lon. 99° W. we observed some little things floating by the ship, which on examination proved to be *small stones*, resembling pumice stone. From their appearance I should suppose they were of volcanic origin. We sailed upwards of fifty miles through them, thinly scattered over the surface of the sea. We were about five hundred and forty miles from the continent, six hundred from the Gallipagos, and six hundred from Clipperton Rock. The northeast trade winds prevail in these latitudes. I can form no satisfactory opinion whence they came, excepting from some volcanic eruption at the bottom of the ocean. As I send you specimens, you can forward part of them to Prof. Silliman.*

"The meteoric shower in November, 1834, was seen in California."—*Boston Daily Advertiser.*

Volcano at Sea.—We copied into the last Gazette, from the Boston Daily Advertiser, an account of a shipmaster sailing many miles along the coast of California, through floating bodies of small light stones, resembling those which are cast out by volcanoes. Capt. Bradshaw, of Beverly, of the ship Lagodan, brought to our office yesterday, a specimen of the same sort of stones, which he picked up on the 27th of April, 1835, in lat. 13° N. lon. 108° W. Capt. B. sailed about twenty miles through these stones, with which the top of the water was thickly covered. It will be seen, by a comparison of the latitudes and longitudes, that Capt. Bradshaw was six hundred miles distant from the place where the stones were picked up by the other ship.—*Salem Gazette.*

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* These specimens, forwarded to us by some unknown friend, are decidedly pumice stone, hardly distinguishable from those of the Lipari Islands. Color light gray—structure, vesicular and fibrous, or filamentous—float on fresh water, with half their volume out at first, until they grow heavier by absorption. They destroy the polish of glass, and appear to have been some time afloat, as they are considerably worn by friction: they have a distinctly saline taste. They were undoubtedly the ejections of a volcano.—Ed.

10. *Visit to Iceland.*—Extracts from an account of a visit to Iceland, by M. Eugene Robert.—Bulletin de la Société Géologique de France. Tom. vii. Feuilles 1–2.

The siliceous concretions formed by the Geysers of Iceland, cover an extent of four leagues in length, throughout which traces of ancient geysers are numerous. We have hence been enabled to observe this singular formation under all its different forms; passing by insensible shades from a loose friable state, the result of a rapid deposition, to the most compact and transparent. We have not only observed impressions of the leaves of the birch tree, of equiseta and different grasses, but the *branches* of the birch are in many places very distinctly recognizable, presenting much the appearance of our agatized woods. At the present time not one of the plants here occurring, are found on the island, and it may be considered probable that their destruction is owing to the invading silica.

The numerous thermal springs, in the midst of which the Geysers are situated, occupy large valleys in the interior of the island.

Appearances indicate that these waters proceed from deep crevices, in which they have been heated by contact with the volcanic fires. It is worthy of note that the action of the Geysers is never more magnificent than during an inundation of the valley by rain. The rivers proceeding from these springs often resemble milk in appearance, owing to the argillaceous bole which they take up in their passage among the siliceous concretions. Such are the white rivers of Olafsai.

Mt. Hecla, like all the mountains of Iceland, is entirely covered with snow, and not the least smoke appears about its summit. The obsidian found in a rolled state on its side, and the pumice stone, form a bed of thirty feet. Fragments of branches of the birch tree occur in the midst of this bed, the remains of the ancient forests of the island which the volcanic eruptions have entirely destroyed.

11. *Storms.*—It appears from the following notice that the mode of investigation by which Mr. Redfield has developed the true character of American storms, has been adopted with success by the meteorologists of Europe.

Meteorological Society, Dec. 13.—Dr. Birkbeck, President, in the chair. Several highly interesting communications were read on the tremendous gale that visited this island on the 29th of November last. The most important were from the Rev. W. B. Clarke, of Poole, Captain W. H. Smyth, R. N., of the Observatory, Bedford, the Rev. W. T. Bree, of Allersley Rectory, near Coventry, Mr. W. H. Campbell, Secretary to the Botanical Society of Edinburgh, and Mr. S. G. Tatem, of High Wycombe.

From the manner in which the wind was observed to change its direction at various places during the gale, it was considered to belong to that class of hurricanes which traverse the western Atlantic. These hurricanes consist of a large body of air moving with considerable velocity round an axis which advances in such a direction as to describe an elliptic or parabolic curve, the apex of the curve being situated about the parallel of the thirtieth degree of north latitude. It was requested, that on future occasions observers would be careful to note particularly the phases of the storms, and the time when any change in the direction of the wind takes place.—*Loudon's Magazine of Nat. Hist., January,* 1837.

12. *Galvanism.*—Dr. Charles G. Page, of Salem, Mass., has lately made the valuable discovery that iron, lead, or any metal, may be substituted for the expensive article of copper in galvanic batteries, whereby the cost of this apparatus will be diminished by about one half. In order that a battery of this construction should equal one of copper and zinc, it is necessary that the exciting liquid should be some acid, holding the oxide of copper in solution, such as the nitrate or sulphate of copper. A solution of blue vitriol or the sulphate of copper, is preferable from its cheapness. A small plate of lead and zinc, each the size of a cent, immersed in a wine glass of the above solution, will give bright sparks, strong shocks, and produce decompositions when connected with a spiral coil of copper ribbon three hundred and twenty feet long, which is, for convenience, now generally called a dynamic multiplier. The superior action of such batteries appears to be owing to the greater readiness with which copper deposits upon another metal than itself. He has further found

that a tolerable good battery may be made of one metal only, viz. zinc, provided one of the plates much exceeds the other in size, and the sulphate of copper be used as the exciting liquid. To construct a battery of this description, a number of narrow strips of sheet zinc, arranged in the form of a cylinder, are immersed in a cylinder of zinc containing a solution of the sulphate or nitrate of copper; the zinc strips answering merely for conductors.

Among other discoveries lately made by Dr. Page in relation to this subject, we notice the production of sparks and shocks from a thermo-electric apparatus, consisting of a pair of bismuth and antimony plates heated by a spirit lamp. This condition has hitherto been wanting to establish fully the identity of thermo-electric, with common galvanic currents.—*Salem Observer.*

13. *Animal Electricity;* by MM. LINARI and MATTEUCCI.—The five helices employed by M. Linari, contained five hundred and seventy seven metres of copper wire. Two had the ordinary form; the three remaining were composed of the wire wound round spirally in a plane, and had a square perimeter. Through one of these helices was passed a cylinder of iron, 0^{m} 635 long, and 0^{m} 31 in diameter. This system of helices was connected and terminated by two plates of silver, provided each with an isolating handle. The circuit was interrupted by cutting the wire between the last helix and one of the plates of silver, in order to insert the extremities of the wire into a vessel of mercury and thus amalgamate them.

The experiment was performed as follows: the torpedo wiped dry, was placed on a plate of glass, with one of the pieces of silver upon his back and the other on his belly. The animal was then irritated by striking him with one of the plates on his tail and gills, and was thus induced to discharge himself. After several trials, M. Linari succeeded in obtaining a spark, which appeared between the mercury and the wire. By touching together the amalgamated wires out of the mercury, he succeeded in obtaining a succession of brilliant sparks. He observed no difference in the capabilities of torpedoes of different sizes to produce this result. A small one of four inches in diameter afforded a long succession of bright sparks.

The decomposition of acidulated water, and a durable magnetization of a steel needle were invariably obtained by M. Linari.

M. Matteucci employed in his experiments similar apparatus to that of Linari, containing however only three hundred metres of wire, of which he made two double helices. One of these helices was 0^{m} 44 in length, and had a diameter of 0^{m} 05m; the other was 0^{m} 72 metres in length, and 0^{m} 03 in diameter, and was wound on a horse shoe. In the interior of the two helices was placed a cylindrical bar of soft iron. With this arrangement, completed as above described, Matteucci succeeded without fail in obtaining a bright spark. One of the helices wound on a horse shoe sufficed to produce the same successful result.

Matteucci attempted to obtain the electric spark by means of two plates of brass, with short wires attached and inserted into mercury. But, notwithstanding the employment of every means which could insure success, he failed in obtaining any effect except the shock. He therefore infers, since the spark is not obtained with a very short wire, and on the contrary is easily obtained with the above described helices, that the spark is produced where the discharge ceases, in which case the current, *by induction*, adds to the primitive current.

He has also ascertained, by means of a delicate galvanometer, that the current passes from the back to the venter, and that the back may be considered the positive pole and the venter the negative. The discharge is effected in the same manner by the two organs situated on the sides of the torpedo, and the current is produced in the same directions when one of the needles of the galvanometer touches the ventral part of the left organ and back part of the right, or inversely. The deviation in the galvanometer is augmented if the two needles of platinum are put in contact with two metallic plates placed on the two sides of the fish, instead of a direct application of the needles. A discharge can almost invariably be produced by forcibly curving the torpedo, making the venter the interior of the curve. A removal of the skin of the animal diminishes the deviation, but does not entirely prevent it. If the outer of the three nervous cords which proceed from the brain to the electric organs are cut, the electric discharge may still continue. It ceases immediately on cutting the intermediate one.

These experiments were tried with thirty six individuals, which M. Matteucci obtained during a long residence at Cesenatico.—*L'Institut, No.* 167. *July,* 1836.

14. *Fall of Fishes from the Atmosphere in India;* by M. Prinsep.—The fact that fishes fall from the atmosphere in the rainy season, however incredible it may appear, has been so frequently attested

by credible witnesses that it can scarcely be doubted. As for myself, my credulity is compelled to yield to the discovery I made one day of a small fish, in my pluviometer, which was situated on an isolated pile of stones about five feet high, in my garden at Benares. A note from M. Cameron informs me that a rain of fishes occurred on the 19th of February, 1830, near Feridpoor. This fact was asserted before a magistrate, by many ocular witnesses, and it was their concurring testimony that towards noon of the above mentioned day, the sky was obscured, the rain commenced to fall, and shortly after, fishes of various sizes fell from the atmosphere. A large number were collected by several witnesses; some were found destitute of a head, and had commenced to putrefy; others were entire and fresh, but no one dared to eat them.—*Bib. Universelle, No.* 3, *Mars*, 1836.

15. *Nature of different Cements.* (Berzelius's Jahresbericht, etc. xivth year, 1st number.)

Fuchs has studied the nature of different species of mortars, and demonstrated that their solidification depends on the formation of silicate of lime, and sometimes also of silicate of alumine. These silicates retain some water and assume the firmness of stone, whilst the hydrate of lime in excess unites by degrees with carbonic acid; and consequently solidified mortar may be considered a compound of carbonate of lime and of a zeolite. *Opal*, *pumice stone*, *obsidian* and *pitch stone* pulverized, form with hydrate of lime a good cement. But only the surface of each grain of *quartz* or *sand*, is transformed into a hydrated silicate, and though this is sufficient to unite the mass, solidification does not take place so promptly. The mass becomes the more solid, the more finely the quartz is pulverized. If the pulverized quartz be mingled with one fourth part of lime, and after thoroughly calcining the mixture, it be pulverized and mixed with one fifth part of lime, it forms a hydraulic cement which becomes so hard as to be susceptible of a polish. Feldspar hardens slowly, and with lime only after five months; but if calcined with a little lime it is much improved. Common potter's clay, which is absolutely worthless in its natural state, affords with lime, when calcined, provided it contains but little iron, a cement which readily hardens.

Fuchs having discovered that *steatite*, which had been subjected to a red heat, could not be made to unite with lime, and thence concluding that magnesia has a strong affinity for silicic acid, attempted to employ calcined dolomite, in the place of ordinary lime, and found that it surpassed it, both as a material for ordinary mortar, and also for a hydraulic cement. He obtained a good mortar with this last material and calcined marl.

16. *Telegraphs.*—The House of Representatives of the United States, at their late session, Feb. 3, 1837, passed a resolve,

"That the Secretary of the Treasury be requested to report to the House of Representatives, at its next session, upon the propriety of establishing a system of telegraphs for the United States."

In compliance with this resolution, the Secretary, the Hon. Levi Woodbury, has issued a circular, with the view of obtaining information in regard to "the propriety of establishing a system of telegraphs for the United States," and invites the collectors, commanders of revenue cutters, and others, to furnish the Department of State with their opinions upon the subject, especially by pointing out the manner, and the various particulars, in which the system may be rendered most useful to the Government of the United States, and the public generally. It would be desirable, to present a detailed statement as to the proper points for the location, and distance of the stations from each other, with general rules for the regulation of the system, together with an opinion as to the propriety of connecting it with any existing department of the Government, and some definite idea of the rapidity with which intelligence could, ordinarily, and, also, in urgent cases, be communicated between distant places. An estimate of the probable expense of establishing and supporting telegraphs, upon the most approved system, for any given distance, during any specified period, is also desired. Information and opinions are also asked as to the practicability of uniting with a system of telegraphs for communication in clear weather and in the day time, another for communication in fogs, by cannon or otherwise, and in the night, by the same mode, or by rockets and fires, and returns are asked by the first of October, 1837.

As the subject is one of high importance to national and individual welfare, especially in a country of such vast extent and diversity of interests and physical features as the United States, we trust that the call of the House of Representatives and of the Hon. Secretary will meet with prompt attention and full replies.

17. *Scientific Congress at Metz.*—A circular printed letter which we have received, signed by M. Victor Simon, Secretaire de L'Academie royale de Metz, &c. &c. &c., announces that a scientific meeting of savans of France, Germany, and other countries, will be held at Metz in September. It is desired that the purpose of attending may be made known, and also the subject which the individual will discuss. This is the fifth meeting of the French scientific men, held in different cities in the departments.

Metz is about sixty five miles northeast of Paris; it is an ancient and famous city. It has eminent individuals, and various institutions for science and arts—for literature, humanity and arms. It has fine Roman antiquities, and is in the midst of a beautiful country. We trust that some of our countrymen will attend, as they have done in England as well as on the continent.

18. *New York Statistical Society.*—A statistical society has been recently incorporated by the Legislature of the state for the city of New York. Its capital stock is fifty thousand dollars, in shares of two hundred and fifty dollars each; the society to commence operations when the whole sum shall have been subscribed and five thousand dollars paid in. It may hold real estate convenient for the transaction of its business, provided the income does not exceed five thousand dollars.

The society is modelled upon the plan of that of London, incorporated in 1834.

All opinions are excluded—facts only being its object, and as far as possible, those that can be arranged in a numerical and tabular form. The subject was divided by the British Association at Cambridge, into 1. Economical—2. Political—3. Medical—and 4. Moral and Intellectual Statistics. The class of

Economical Statistics comprehends, 1st, the statistics of the natural productions and the agriculture of nations; 2dly, of manufactures; 3dly, of commerce and currency; 4thly, of the distribution of wealth, or all facts relating to rent, wages, profits, etc.

Political Statistics furnish three subdivisions, 1st, the facts relating to the elements of political institutions, the number of electors, jurors, etc.; 2dly, legal statistics; 3dly, the statistics of finance and of national expenditure, and of civil and military establishments.

Medical Statistics, strictly so called, will require at least two subdivisions, and the great subject of population, although it might be classed elsewhere, yet touches medical statistics on so many points, that it would be placed most conveniently, perhaps, in this division, and would constitute a third subdivision.

Moral and Intellectual Statistics comprehend, 1st, the statistics of literature; 2dly, of education; 3dly, of religious instruction and ecclesiastical institutions; 4thly, of crime. Although fourteen subdivisions have now been enumerated, it is probable more will be required.

It will, of course, be one prominent object of the society to form a statistical library, as rapidly as its funds will admit.

The gentlemen incorporated by the New York act, are James Tallmadge, James M. Matthews, Edwin Williams, Talman J. Waters, William Minot Mitchell, Samuel Cowdrey, and their associates, and the board of trust, for the present season, is composed of the same gentlemen, with the addition of Livingston Livingston, George Bacon, Benjamin D. Silliman, John W. Francis, Timothy Dewey, Reuben Ellis, and Jonathan Amory, with power to perpetuate the succession.

The subject of statistical societies for the United States, was recommended in this Journal, Vol. xxxi. p. 186, by Mr. Sanderson, as the representative of the Statistical Society of Paris, with which we have interchanged publications and correspondence ever since its institution. Although from the pressure of other duties we have been obliged to decline taking an active part in this subject, we are much gratified to find that it has been brought forward under the best auspices. The subject is one of extreme importance to the United States, in every view that can be taken of it—political, social, moral, economical, commercial: accurate facts, digested and arranged, so that the proper deductions shall of course flow from them, are no where so much needed as in the United States, because we are still in the forming stage of society—because our interests are immensely diversified, and because in this republic, beyond any nation that exists, or that ever did exist—man, in high intelligence, is in a state of the greatest activity, with the most numerous and powerful excitements and with the feeblest restraints. Political economy must be founded wholly upon statistics, and there is no way to obtain correct results but by a patient collection of facts.

Our able statistical writers, Seybert and Pitkin, would have derived immense advantages from the labors of such a society, and we hope to see its operations and influence become co-extensive with the nation. It is obvious that the subject admits, on this occasion, of cogent and ample illustration, from which we are precluded by the want of time and space.

19. *Officers of the New York Lyceum of Natural History, elected February* 27, 1837.

Joseph Delafield, *President.*
John Torrey, *1st Vice President.*
William Cooper, *2d Vice President.*
Samuel Thos. Carey, *Corresponding Secretary.*
J. H. Redfield, *Recording Secretary.*
John C. Jay, *Treasurer.*
Robert H. Browne, *Librarian.*

Joseph Delafield, Abraham Halsey, James E. DeKay, John C. Jay, E. L. Beadle, *Curators.*

John Augustine Smith, Jeremiah Van Renssalaer, Wm. Cooper, John Torrey, M. C. Perry, *Committee of Nomination.*

Wm. Cooper, Joseph Delafield, John Torrey, James E. DeKay, John C. Jay, *Committee of Publication.*

H. W. Field, A. R. Thompson, Archibald Russell, *Finance Committee.*

James E. DeKay, Orville Brooks, E. L. Beadle, *Library Committee.*

John Augustine Smith, *Anniversary Orator.*

J. H. Hill, *Draughtsman.*

20. *Transactions of the Maryland Academy of Science and Literature,* 1836. *June* 2.—Donations for the Cabinet were received from Dr. Keener, Mr. Alexander, Dr. Baxley, Dr. Geddings and Dr. Coale, and from Prof. Ducatel and Matthew Carey, Esq. of Philadelphia, several works for the Library.—Twelve volumes of the transactions of the Royal Society of Lisbon, were also received as a donation from that Institution.—Prof. Ducatel deposited in the library six livraisons of Goldfuss' Petrifactions.—Dr. Edmondson reported a table of Meteorological Observations for May, 1836, which was referred to the section of Physics.—The committee on Meteorological Observations made a report recommending the appointment of a committee of four, to have charge of the selection and construction of instruments—to prescribe the method of conducting the observations—and to invite the co-operation of other

members, in the labor of observations.—Lewis Brantz, James Green, J. H. Alexander, and Wm. R. Fisher, were appointed the committee.—Prof. Jameson, of Quito, Dr. Lewis R. Gibbes, of Charleston, and Rev. Virgil H. Barber, of Pennsylvania, were elected corresponding members; Commandeur Figaniere, chargé d'affaires from Portugal, was elected an honorary member.—The librarian was directed to have Greenough's Geological Map of England, deposited by Prof. Ducatel, mounted and varnished.

July 7.—A donation of valuable minerals was received from C. Tiernan, Esq.—Several works were also presented to the library by Dr. Riddell, of Cincinnati, and Drs. Wright and Hall, of Troy.—The committee on Meteorological Observations reported having procured the necessary instruments, and made the observation proposed on the 21st and 22d ultimo.

August 4.—Donations for the cabinet were received from Dr. A. Maddox, of Maryland, Mr. C. De Selding, J. S. Skinner, Esq., Mr. N. Potter, Mr. G. W. Andrews, and Dr. Coale.—Mr. Alexander presented a copy of a treatise on the principal mathematical instruments employed in surveying, by F. W. Sims; American edition with additions by J. H. Alexander.—The committee on Meteorological Observations made a final report, which was directed to be printed and circulated.

September 1.—Donations for the cabinet were received from Dr. Geddings, J. S. Skinner, Esq., Dr. Cohen, Mr. Minifie, Mr. Green, Mr. Fisher, and Dr. Coale.—Donations for the library were received from Dr. Riddell, of Cincinnati, Mr. Carey, Esq., of Philadelphia, and Wm. Maclure, Esq.—Dr. Edmondson reported a table of Meteorological Observations for July, 1836, which was referred.—M. Carey, Esq., of Philadelphia, was elected a corresponding member.—The meteorological committee was directed to continue their duties on the 21st and 22d inst.

October 6.—Dr. Maddox, Dr. Geddings, Dr. Palmer, U. S. Navy, and Mr. Minifie, presented specimens for the cabinet.—A treatise on the method of using chloride of soda, translated from the French of A. G. Labarraque, by Dr. Jacob Porter, was presented by the author.—James C. Palmer, M. D., U. S. Navy, and Dr. L. D. Gale, of New York, were elected corresponding members.—The committee on Meteorological Observations reported that the series of hourly observations had been made on the 21st and 22d of September, and that the table was being prepared for publication.

October 13.—The cabinet received donations from Mr. Minifie and Dr. Coale.—Charles Cramer, Esq. of New York, presented a catalogue of plants growing in the vicinity of Troy; and the Report of the Geological Society of Brussels.—Dr. Edmondson reported a table of Meteorological Observations for August, 1836.—Dr. J. W. Greetham reported a table of observations made at Mt. Vernon, Illinois, for June and July, 1836, both of which were referred to the section of Physics.—The chairman of the section cf Botany reported progress in the arrangement of plants referred to that section.—Dr. Aikin was appointed to lecture at the sitting of the 27th inst.

October 20.—Dr. Coale presented the skeleton of a wren.—The section of Physics reported upon the tables referred at the last sitting, embracing in the report, suggestions of some modifications, which were approved by the Academy.—The section of Mineralogy reported the receipt of a suite of geological specimens from Heidelburg, and that they had been placed in the cabinet.

October 27.—Donations for the cabinet, from Mr. Quinby, Dr. Coale, Dr. Zollickhoffer, and the Maryland Colonization Society.—The remainder of the session was occupied by an interesting lecture from Mr. Quinby, on the mineralogy of the ancients, which was listened to with much attention, and a copy requested from the author for preservation in the library.

November 3.—Dr. Coale presented for the cabinet the skin of a monkey, tanned by the natives of Cape Palmas.—Donations for the library from Prof. Ducatel, Dr. Dunbar, Prof. W. R. Johnson, of Philadelphia, and Com. Figaniere.—Dr. Aikin delivered a lecture on the anatomy of plants.—Dr. Henry P. Sartwell, of Penn Yan, N. Y., was elected a corresponding member.—Mr. Fisher informed the Academy that the arseniate of baryta, recommended by him at a former meeting, he had since ascertained should be employed only when the use of powdered arsenic was impossible—hence its use should be confined to the preservation of the plumage of birds.—Mr. Fisher was appointed to read a paper at the following sitting, and Prof. Ducatel at the succeeding one.

November 10.—Dr. Coale presented the prepared skeleton of a "Corvus crestata."—Mr. Fisher read a paper on the present state of Pharmacy in the United States.—J. J. Audubon was elected an honorary member of the Academy.

November 17.—Donations for the cabinet were received from Mr. J. H. Naff, Dr. Riley, and Dr. Coale.—Prof. Ducatel read the introduction to an essay on the submersion of the Atlantis, being an attempt to show the reality of this event, and its probable connection with some geological phenomena.—Prof. Geddings gave a brief account of the insect which has proved so destructive to the elm tree. He described it as belonging to the genus *Crioceros*, species *vittata;* and concluded with a description of the mode in which the eggs are deposited, and the insect subsequently developed.

November 24.—Donations were received of several skulls and casts of skulls from Dr. Coale, and a specimen of the new British coin from Miss Minifie.—A circular letter was received from the Albany Institute, requesting the Academy to undertake a series of magnetic experiments, and acknowledging the receipt of the table of Meteorological Observations for June. The subject was referred to the meteorological committee.

NOTICES OF NEW BOOKS.

21. *Proposed New Work on American Skulls;* by Dr. SAMUEL GEORGE MORTON.—Dr. Morton has, for several years, employed his leisure in collecting materials for a work, to be entitled "*Crania Americana; or, a Comparative View of the Skulls of various Aboriginal Nations of North and South America.*"

It is presumed that such a work, independently of its great *Anatomical* interest, will contribute something towards the *History* of the nations of these continents. The work will be in large folio, with twenty five or thirty plates, and two heads on a plate. It is designed to have at least fifty skulls lithographed of the natural size, with such national, individual, and anatomical illustrations, as can be obtained in reference to each. The work will be preceded by an INTRODUCTION, embracing a general view of the five great *Races* of Men, and followed by an exposition of the probable origin of the American Tribes.

Of one hundred and forty skulls of all the races now in Dr. Morton's possession, but sixty three belong to American tribes, and but twenty three of these are North Americans. Valuable as this collection is, and by far the most extensive of its kind in this country, it is yet very inadequate to the purposes above mentioned; and Dr. M. therefore respectfully solicits assistance in extending and completing it. The skull of any native tribe, if sufficiently perfect to figure, will be highly prized; and, where practicable, several individuals of the same tribe will serve an important purpose for comparison. The latter object will also be more or less subserved by the skulls of any of the races, more especially those of the Mongolian and Malay, as approaching nearest to the American.

22. *New Theoretical and Practical Treatise on Navigation, by M. F. Maury, Passed Midshipman, U. S. N.* 8vo. pp. 216, and 174 of tables, 9 plates. Key & Biddle, Philadelphia, 1836.—The author of this Treatise, is already favorably known to the public for his contributions to science, and the work before us amply sustains his character as an officer well grounded in the varied learning demanded in his profession. The work is appropriately introduced with chapters on Algebra, Geometry, Logarithms, Plane and Spherical Trigonometry, which contain whatever knowledge of these topics is deemed essential to a thorough understanding of the theory of navigation. The section on Nautical Astronomy and Practical Navigation, which next follows, unfolds these subjects in a logical and comprehensive manner; and also imparts much important instruction on the variation of the Compass, the Tides, and on the mode of conducting triangulating surveys. Appended to the work, are tables of Logarithms of Numbers; of Sines, Tangents, &c.; Proportional Logarithms; Latitude and Departure; Meridional Parts; Amplitudes; Atmospherical Refractions, &c. The style of the treatise deserves much praise; it unites fullness of statement with brevity and precision. The estimation in which the work is held among those best qualified to appreciate its worth, may be inferred from the fact that a copy has been ordered to be placed on board all our national vessels. It cannot fail to be of important service to the interests of nautical science.

23. *Gummere's Astronomy.*—An Elementary Treatise on Astronomy—in two parts—the first containing the Theory, the second Practical Problems—with an Appendix comprising Solar, Lunar, and other Astronomical Tables. By JOHN GUMMERE, A. M. Second edition, enlarged and improved. Philadelphia, 1837.

We are glad to see Gummere's Astronomy presented to the public in a new and improved form. It is a valuable work, evincing a good acquaintance with the subject of which it treats, and comprising, (what can hardly be said of any other American work on the elements of Astronomy,) facilities for actually making astronomical calculations. The Solar and Lunar tables are abridged from those of Delambre and Buckhardt, and are of course of the highest authority. The astronomical student, however, may be informed, that the originals are not expensive, and, when practicable, they ought to be in his possession in preference to any abridgment. Still the tables, as given in this work, will be found adequate to the purposes of the beginner, and will indeed conduct him to a more accurate result than he can attain by the aid of most works of this kind.

The analytical methods of calculating eclipses, which the author has given, are refined and ingenious. For a school book, which will, we hope, be used in many institutions where Analytical Trigonometry has been little cultivated, it might, indeed, be desirable to exhibit a few examples of the plainer and more ordinary methods of making such calculations. We trust, nevertheless, that the rapid progress which mathematical science is making in our country, will shortly render such a provision unnecessary. We will only add the hope, that this work, the fruit of much industry and ability, will receive the extensive patronage which it merits.

24. *Twelve Lectures on the connection between Science and Revealed Religion;* delivered in Rome, by *Nicholas Wiseman, D. D.*, Principal of the English College, and Professor in the University of Rome. Andover, 1837.—We did not look to Rome for a book of this kind; much less did we expect so able a discussion of the relation of Geology to the Mosaic history. Had we time and space, it would be highly interesting and instructive to give a full analysis of the whole book; as it is, however, we must content ourselves with briefly noticing his geological disquisitions. These are contained in the fifth and sixth lectures, under the head of "THE NATURAL SCIENCES." Although he does not enter *minutely* into geological discussion, he shows at every step of his argument that he is familiar with the great facts in geology, and with the general course of geological reasoning, and that what he says comes from a mind well stored by extensive and various reading, and matured by reflection. He says, with all other true philosophers, that we need have no fear in following truth, however far her torch may lead us from our preconceived opinions; confident, that in the end, she will not be inconsistent with herself. While our author is catholic, in the largest and best

sense of that word—no protestant could be more jealous of the truth and authenticity of sacred writ. We trust our friends among the clergy will read this book; they will find in it an example of candor and courtesy worthy of all imitation, while it is remarkable for its condensed learning and its fine taste. His two lectures on the natural history of man, are profound, and profoundly interesting, as indeed is the whole book as far as we have examined, although we do not feel ourselves competent to judge of the philological portions. The eight lectures we have not mentioned, consist of two on the *Comparative Study of Languages*, two on *Early History*, one on *Archæology*, two on *Oriental Languages*, with a concluding lecture.

25. *Dr. Buckland's New Work.*—Dr. Buckland's admirable Bridgewater Treatise has been republished in Philadelphia, with all its illustrations. Our opinion of this work was given in Vol. XXXI. p. 419, and want of time and space alone have prevented us from saying more of it in the present number.

26. *Lyell's Geology, 5th edition.*—The 5th edition of this excellent work, with considerable additions, and many new cuts in wood, has recently appeared in England, and we understand that the English copies are imported in large numbers into this country by some of our principal booksellers.

An American edition by Is. Kay and brother, is also about to appear in Philadelphia, copied with all the illustrations from the fifth English edition. We understand that the four large English duodecimo volumes will be published in two octavos, to be ready for sale in the month of May. Our opinion of this work is expressed in Vol. XXIX. p. 358, of this Journal.

27. *An Introduction to Botany, by John Lindley, F. R. S., &c. &c.* Second edition, with corrections and numerous additions. London, Longman & Co., 1835. 8vo. pp. 560.—The estimation which this excellent treatise so deservedly holds, is evinced by the early appearance of a second edition; the important additions to which, indicate the rapid progress of the science of Botany during the two years that have intervened between the first appearance of the work and the publication of the present edition. It is illustrated by numerous wood engravings, and six crowded and beautifully executed copper-plates.

28. *A Natural System of Botany, or a Systematic View of the organization, natural affinities, and geographical distribution of the whole vegetable kingdom, together with the uses of the most important species in medicine, the arts, and rural or domestic economy, by John Lindley, F. R. S., &c. &c.* Second edition, with numerous additions and corrections, and a complete list of genera, with their synonymes. London, Longman & Co., 1836. 8vo. pp. 526.—The students of Botany in this country are generally acquainted with the first edition of this work, through the American reprint, edited by Dr. Torrey, and published by the Messrs. Carvill, of New York. The edition now before us is so greatly improved by the addition of original matter, and especially by the arrangement of the orders upon entirely different principles, that it might almost be considered a new work. The preparation of a complete list of genera, properly arranged under their respective orders, sub-orders, &c. must have been a very laborious and difficult task. It was, however, greatly needed, as, until its appearance, there has been no general enumeration later than that in the *Ordines Plantarum* of Bartling, published in the year 1830.

A more extended notice of the work may be expected in the ensuing number of this Journal.

29. *Hints on the cultivation of the Mulberry, with some general observations on the Production of Silk, by Lewis Tinelli,* Dr. of Civil Law in the Univ. of Pavia. New York, 1837.—This little book of about 50 pages 8vo., is designed chiefly to show that the cultivation of the mulberry and the growth of silk are as well suited to the soil and climate of the United States as to European countries. He begins with a brief history of the seropedic art, and then shows the prevailing opinion to be false that the successful growth of the mulberry requires a warm climate. In proof of this, he adduces the fact that Switzerland, Germany, and even Sweden, produce silk in large quantities and of excellent quality; and Lombardy, where some of the best silk in market is grown, is frequently covered with snow for two months of the year. He gives the preference to the MORUS MULTICAULIS for this country, since it is so easily propagated by cuttings and requires no very peculiar soil. Our interest in the book is increased from the fact that the author is one of those injured and unfortunate men whom the tyrannical power of Austria has driven as exiles to our free and happy country, after wasting their bodies by years of severe imprisonment in her gloomy dungeons.

30. *Chemical Tables, exhibiting the present state of our knowledge in regard to the chemical and physical properties of simple and compound bodies, by James F. W. Johnston, A. M., F. R. S. E., F. G. S., &c. &c.* Part I. Edinburgh, 1836.—Several months since we received a note from the author of these tables, accompanying a copy, and also a blank schedule for chemical information, which was published in our last number, (p. 414.) Nothing but want of space prevented our noticing them at that time. The tables are drawn up at the request of the British Association, and they present another proof of the services which that body is constantly rendering to science. Prefixed to these tables is an explanation of their object and use. Dr. Johnston states it as a prime object to show what we do not know, as well as what we do; and he justly remarks, that some will be surprised to find how ignorant we are in *many particulars* of the most familiar bodies. He uses the symbols of Berzelius and the German chemists. Part 1st commences with inorganic bodies, and the first section contains an exhibition of the most important chemical and physical properties of the non-metallic elementary substances, and of their mutual combinations. Such a work is calculated to be highly useful, and to enlist new laborers in the field of original research.

NEW JOURNALS.

31. *Magazine of Zoology and Botany;* conducted by *Sir Wm. Jardine*, Bart., *P. J. Selby*, Esq., and *Dr. Johnston.*—The first No. of a Journal bearing the foregoing title was published last June. Four numbers—those for June, August, October, and December, have come to hand. If we may, from these numbers, judge what its character is to be, it will take the lead in its own departments, as well for original research and accurate monographs, as for a succinct and interesting abstract of all that is new, both in facts and the issues of the press. The names of its conductors are too justly celebrated to gain additional lustre from any thing we can say of them. Its character, we learn from the prospectus, is to be more scientific than that of any of the pre-existing journals of Natural History, and thus far it is well sustained.

32. *Thomson's Records of Science.*—It is now nearly two years since the first number of this excellent Journal made its appearance,

and although we have never before mentioned it to our readers, they will remember that it has often enriched our pages, and we also hope that many of them have a more familiar acquaintance with it. While it has fully maintained its character as a scientific journal of the first class, its pages have not been too much engrossed by mathematics and mere technicalities. We are sorry to learn from its able conductor, that like some of its cotemporaries it has lived by the hardest, and thus far barely paid its expenses. May it live to see brighter days, as it richly deserves.

33. *The Annals of Electricity, Magnetism and Chemistry, and Guardian of Experimental Science;* conducted by *William Sturgeon.* London, October, 1836, Vol. I, No. 1. Published quarterly. Price 2*s.* 6*d.*—A new journal of the above title has been sent us by the Editor, since the publication of our last number. Its prospectus states that it is to be devoted entirely to recording *all* that is new and interesting, either theoretical or practical, that may appear on the branches to which it is confined. We hope that it may prove itself worthy of support, and receive the assistance of able men, so many of whom are now engaged in these most important branches of research. The number before us contains two papers from our distinguished countryman, Dr. Hare. Also an account of some experiments by Dr. Henry, of Princeton, (erroneously stated to be of *Yale College,*) as related to Mr. Sturgeon by Col. Peabody, of Salem, Mass.

OBITUARY.

It is with feelings of the deepest sorrow that we are called on to record the death of Dr. Turner, the distinguished author of "Elements of Chemistry." In the "*Athenæum,*" of February 18th, we find the following painfully interesting facts:

"He died on Sunday, 12th February, at his residence at Hampstead, aged 40. The immediate cause of his death was inflammation of the lungs, which commenced in an attack of influenza. He had been suffering for many years under chronic affection of the intestines, by which his strength was extremely reduced.

"Dr. Edward Turner was born in Jamaica, but was early removed, for his education, to England. He graduated as Doctor of Medicine in Edinburgh. Having determined to make Chemistry the principal object of his study, he went, even after taking his degree, to Göttingen, where he continued for two years, devoting his whole attention, under Professor Stromeyer, to that science and the kindred one of mineralogy. He returned to Edinburgh in 1824, and began to lecture on his favorite science. On the foundation of the University of London, in 1828, he was appointed Professor of Chemistry at that Institution, to the success of which, as a medical school especially, by his character, his abilities, his indefatigable exertions as a man of science and as a teacher, his prudence, and the amenity of his manners, he has contributed a very ample share. His class has been large and constantly flourishing; his lectures were remarkable for the simplicity and clearness with which the most apparently complicated principles and facts were expounded, insomuch that he was considered by his pupils a model of an effective teacher. He always maintained and was most successful in showing that a course of instruction in any one department of knowledge may be made a high mental exercise, and the means of invigorating generally the reasoning powers."

"Dr. Turner's first publication was a small treatise on the Atomic Theory. He was the author of several papers in scientific periodicals, and in the Transactions of the Royal Societies of Edinburgh and London, of both which societies he was a Fellow.

"If Dr. Turner had not been so much distinguished by his enlarged intelligence, his consummate ability as a teacher and his fame as a chemist, he would have been nevertheless remarkable for his high moral qualities. It was impossible to have passed the shortest time in his society, or even to have "looked in his face," without being struck by the extraordinary amenity and benevolence which were his characteristics. It is a fact well known to those intimately acquainted with him, that his temper never appeared ruffled, and the tranquilizing effect of his mere presence on the angry feelings of others has often been remarkable.

"Dr. Turner was a member of the established Church of England, and a strict observer of its ordinances; but he afforded an example that sincerity in attachment to its principles is perfectly consistent with the toleration, in spirit, as well as in demeanor, of adverse opinions. His particular religious sentiments were never obtruded, and the strength of his feelings on the subject was known only to his family and most intimate friends.

"In his last moments he was tranquil and "perfectly content to close his career." Exhibiting and expressing the firmness of his faith, and his full trust and confidence in the redeeming effects of the sufferings and merits of Christ, he had his domestics assembled around him to witness the serenity with which he was enabled to contemplate the certain approach of death. It is no exaggerated portraiture of Dr. Turner's character to say, in a few words, that he afforded an extraordinary instance of the combination of the best and highest qualities, most accurate perception, enlarged intelligence, active benevolence, unaffected piety, universal charity."

Persoon.—The learned botanist of the Cape of Good Hope, M. Persoon, is now no more; he died at Paris at a very advanced age, having lived there since he enjoyed a pension from his government, which was granted to him on giving up his Herbarium to the Museum at Leyden. His works on Cryptogamea are excellent; and his Enchiridium Botanicum is one of the most useful works of its kind which has yet been published.—*Athenæum, Feb.* 18, 1837.

Mr. *Richard Cunningham*, the able botanist, who was connected with an expedition in New South Wales, was cruelly murdered by a band of savages, into whose hands he was so unfortunate as to fall, somewhere near the end of April, 1835. Loudon's Gardener's Magazine, contains a thrilling and interesting letter from his afflicted brother, which we have not room to copy. From this letter, we learn that he by accident, became separated from his companions, and after wandering some days, fell in with the savages before mentioned, who gave him food and allowed him to encamp with them for the night; that their suspicions were aroused by Mr. C.'s rising repeatedly in the course of the night, and walking about the encampment; and fearing lest it was his intention to betray them into the hands of some of their enemies, in the neighborhood, they determined, after consultation, to kill him, which they did by rushing on him with their spears. He had just completed his forty second year.

We announce with much regret the death of Mr. *Edward Turner Bennet*, Secretary to the Zoological Society, who died on Sunday, 21st August, after a short illness. By his decease the society has lost one of its most efficient office-bearers, and one whose province it was to detail the interesting additions which were acquired to the mammalia of the collection. In this department he ranked deservedly high; perhaps, so far as Britain is concerned, higher than any one. This will be borne out by the papers he has published in the the Transactions of the Zoological Society,—a work, of which he took the principal superintendence, and which for general execution, stands unrivalled. He is also known as the author of the Tower Menagerie, and the Gardens and Menagerie of the Zoological Society. His name will stand recorded by the Antelope Bennetii, Orthotomus Bennetii, &c. &c.—*Mag. of Zool. and Bot., Edinb.*

The painful news of the death of Dr. *William Henry*, the well known author of a celebrated work on Chemistry, and of many excellent memoirs, has been fully confirmed. In the expectation of a memoir prepared at the request of the Manchester Literary and Philosophical Society, by Dr. Wm. Charles Henry, son of the deceased, we postpone an obituary notice of this lamented philosopher, and excellent man, until ampler means of doing justice to his memory are placed in our hands.

East Indian Geology.

At the last moment, we have received from the author, Assistant Surgeon John McClelland, an original octavo volume, of 384 pages, with full illustrations, and printed in handsome style at Calcutta, Bengal, on the Geology, and other topics of Natural History of the Province of Kemaon, a portion of the region of the Himalayah Mountains. We hail this work with pleasure from this remote region, and shall notice it again on a future occasion.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Observations upon certain Auroral and Optical Phenomena;* by Alexander C. Twining.

The height of auroral phenomena is a subject which has divided philosophers. Some consider them as lying in the lower regions of the atmosphere; while others would elevate them beyond its supposed limits, or at least into its extreme upper regions. It is my intention to prove in three instances of late occurrence, that the latter opinion is the true one.

Auroral Cloud of December, 1835.

On the evening of the 10th of December, 1835, being at the village of New Britain, which is twenty six miles N. and 15° E. from the city of New Haven, I observed attentively, for more than an hour, an auroral cloud of very unusual appearance. At the beginning of my observations, about half past 8 o'clock, P. M. it was situated about 25° east of north, and at an average altitude of 11°. The star Beta Ursae Majoris was enveloped in its upper portion, but not obscured.

This altitude changed only 9° during the period of my observations, although the cloud moved horizontally towards the west not less than 20° in the same time. The cloud had a horizontal extent of at first about 16°; but was narrow (only 4°) in the vertical direction,—being irregular in its *upper* outline, but shaped, on the whole, somewhat like a very excentric semi-ellipse. Its lower limit however was a *well defined line;* and in respect of this feature the cloud continued unchanged, whenever it was visible, through all its expansions and variations. This lower limiting line was not exactly horizontal,—being elevated at first about 3° more at its *western* than at its *eastern* extremity. As the cloud moved round westward, this line assumed gradually a position more nearly horizontal. A remarkable circumstance was that the cloud would disappear at short intervals; after which it would gradually but rapidly light up again in the same place, and with the same shape nearly as before. This process of alternate vanishing and reappearing was continued at intervals of from half a minute to two or three minutes and more, during all my observations. The cloud had not only moved round to the west, but had increased, towards the last, in its horizontal extent to about 33°; but its vertical breadth was not materially changed, and the lower horizontal limit retained its well defined and rectilinear character. It disappeared rather suddenly at about a quarter before ten,—the altitude of its lower limit being then 19½°.

On arriving at New Haven, a day or two afterwards, I found that the same isolated appearance had been viewed attentively by several persons,—by Mr. Stanley, now Professor of Mathematics in Yale College,—by Mr. E. C. Herrick, and by an intelligent gentleman, a member of Yale College. From each of these gentlemen I obtained, previously to communicating my own observations to them, a careful description and delineation of this phenomenon—its changes and its location among the stars,—for the purpose of making three independent comparisons with my own particular minutes respecting the same. By a comparison of the aspects, the changes, the motions, and the time of disappearance, there could not remain a doubt that this cloud, seen at New Haven, was *identical* with the cloud seen by me at New Britain. In this comparison four circumstances conspired to favor a correct result.

First. There was no other auroral appearance seen in any part of the heavens. Therefore the different observers were viewing the *same thing;* which removes one of the usual and most perplexing uncertainties attendant on such comparisons.

Second. The two stations, twenty six miles apart, were nearly in a line with the cloud, and for a part of the time exactly so.

Third. The lower limit of the cloud, being a well defined line, and continuing so throughout, offered an unusually definite object for the estimation of altitudes, and for location by the stars.

Fourth. The motions being chiefly horizontal, and the changes of altitude very slow, an error of several minutes as to the time would not affect the comparison in respect of altitude, except in a trifling degree. Indeed, since the motion of the cloud was almost exactly *along its own rectilinear base*, and since the comparison of the observations at both stations was made by taking the distance of a fixed star (Alpha Draconis) from that base, it being distant only two or three degrees at farthest, it may be asserted that any uncertainty arising from a difference in the watches of the observers, or their estimates of the hour and moment, is completely done away by the circumstances of the phenomena.

Under these favorable circumstances, therefore, comparing the sketch and notes made *on the spot, and at the time of observation*, by Mr. E. C. Herrick, at New Haven, at 9*h*. 15*m*. P. M. with those made under like circumstances by myself at New Britain, and, as it happens, at the same moment, I find the distance from Alpha Draconis to be the same in both cases,—indicating the entire absence of a parallax sufficiently considerable to be detected by this kind of observation,—which is of course not expected to be exact,—within perhaps ½° or 1°.

Prof. Stanley had not minuted his observations, at the time of making them; but before having access to any other observations he fixed carefully by recollection the situation of the phenomenon at 9*h*. 40*m*. P. M. The cloud thus delineated by him was almost *identical* in extent and situation with the same as delineated by myself, at the last specific observation made by me, at 9*h*. 30*m*. at New Britain,—except that the distance of the lower line from Alpha Draconis was in the first case 1° 40′, and in the last 3°—showing a parallax of 1° 20′ only.

The third observer before alluded to, having also delineated *independently* on a celestial map the same cloud as observed by him, gave it a situation, extent and form, agreeing closely with the observations of Prof. Stanley and Mr. Herrick. Not having the map at hand I cannot now state particulars, although at the time this observation afforded a striking confirmation of the truth of the general conclusions we are now about to deduce.

My object is *not*, let it be noticed, to show *the exact distance and height* of the cloud observed, but to exhibit proof of this one fact that it was *elevated, most unquestionably, either above the atmosphere, or into its extreme upper regions.* By Mr. Herrick's observations, compared with my own, made at, or certainly near, the same moment of time, it would appear that the cloud was too distant for a parallax sufficiently considerable to be appreciated. All however that we can safely deduce from this, (and so much is deduced with entire certainty,) is the fact that the parallax was very small.

Again, by combining Professor Stanley's observations with my own, made indeed ten minutes earlier, but still perfectly comparable with them in consequence of the peculiar and propitious circumstances before stated, it would appear that a parallax existed of 1½° between the stations twenty six miles apart. Considering therefore the definite character of the object, and the care taken in the different observations, and even allowing some latitude for errors attendant on the best observations of such bodies, there would seem to be no possible reason for suspecting in this case a parallax of more than 1° or 2°, or at most 3°. Indeed, by assuming the latter amount (3°) we shall be almost certain of assigning to the cloud a distance and height *far less* than the truth.

Assuming however a parallax so large as 3°, between the two stations, twenty six miles apart, and nearly in a line with the cloud,—the elevation at the most northern or nearest station being 19½°, we find, without stating the calculation here, the distance of the cloud from New Haven in a direction a little east of north, to have been one hundred and forty one miles in a direct line; and the height above the surface of the earth to have been *forty two miles and one third.* This is the *nearest* point which we are at liberty to assign. It would have agreed better with our direct observations to have placed the cloud at a height three or four times as great: but in the present state of our knowledge it is most important to settle, if possible beyond dispute, the general question respecting the *region* in which the auroral phenomena have their residence. Therefore I have leaned to the extreme of caution.

Auroral Arch of August, 1836.

On the 12th of August, 1836, being on board one of the Hartford steamboats going to New York, I noticed, early in the evening, auroral lights of considerable brightness and beauty; but without making any particular observations. A little before ten o'clock, P. M. however, there appeared a streamer (as I took it to be) in the west, rising, not vertically, but somewhat obliquely—its higher parts inclining southward, and the whole of a yellowish hue. Just opposite to this, in the eastern quarter of the horizon, I soon noticed another streamer exactly similar and similarly inclined. At those portions of the streamers which were 20° above the horizon the obliquity to the *vertical* was about 17°. These streamers increased steadily in brightness, and their remarkable similarity and correspondence of position led me to look above, in expectation of finding them to be part of a connected line. Immediately over head I at once perceived an arch forming,—in appearance like a thin whitish vapor—well defined but narrow, and so faint that it would not have attracted notice, had not its existence been suspected and sought for. This circumstance seemed at first to suggest a probability that the bow might be arranged in a horizontal stratum of vapor, too faintly luminous, and too thin to make a strong impression on the eye looking *directly* through its substance, and requiring to be viewed through a section *oblique* to its length, and thus to have its successive parts accumulated upon each other, in order to give the impression of brightness. Soon, however, the parts over head increased in brightness, as did also those towards the horizon,—the part in the west being the brightest, and all having the apparent density of a common cirro-cumulous cloud. At 9*h*. 55*m*. I find by my minutes, made at the time, that the arch was *centered* over head in the star *Alpha Lyrae*, which appeared undiminished in brightness. At the same time its centre passed, in the east, through a star which I take to have been *Markab*, and in the west about 5½° to the north of *Arcturus*. It was therefore at this time disposed *nearly* in a great circle, whose meridian passed 15° *east* of north, instead of about 6° west of north, as the magnetic direction of the region would have led us to expect.* At 10*h*. 5*m*. the arch was centered in Arcturus,—then about 20° high in the west. Higher up it cut the southern edge of Corona. Over head it had moved 5⅔° southward in Lyra. In the east it had also advanced southward, but not more than 2° opposite the star before mentioned, then estimated to have 25° of altitude. It thus appeared evident that the western parts of the arch were in a state of more rapid apparent motion than the eastern, or even than the vertex,—since a motion of 5⅔° over head would correspond (supposing the arch horizontal) to about 2° at an altitude of 20°, whereas the observed motion was by estimation 5½°, and possibly rather more. Either therefore the arch was nearer the earth's surface in its western parts, where it was also the brightest, or its visible extreme parts were in motion at unequal velocities. At this time the great circle that would nearly contain the western limb of the arch, would have its meridian about 12° east of north. In the position last given the arch was stationary for ten minutes. It was most brilliant at 10*h.* 15*m.* Two minutes afterwards it separated into parallel *fleeces,* distinct from each other, and lying oblique to the direction of the arch. These fleeces were in slow motion toward the west, keeping the line of the arch. The motion was such as made itself evident to the sight at the first instant of attentive observation. In other words it was sufficiently rapid to be just perceptible *directly* to the sense. At 10*h.* 30*m.* the arch faded almost entirely, so that I considered it as having vanished. Its position was then 11⅓° south of Alpha Lyrae,—south also of Arcturus and the Northern Crown, and south of its previous position in the east. On looking afterwards, I found that the arch had completely formed again in its last position, and was well defined, although faint. It disappeared altogether about 10*h.* 40*m.* P. M. without having changed place. The steamboat at 9*h.* 55*m.*, the time of my most definite observations, was nearly opposite Old Field Point, on Long Island. My position, as closely as I can estimate it, was twenty two miles S. 8° W. from New Haven.

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* This refers to the *western limb* of the arch. The *eastern limb* would have its proximate great circle a few degrees nearer the east and west points. The arch was certainly not disposed in a great circle, as is evident from the fact that the extremities were much inclined to the vertical, while the arch passed through my zenith. It was much more probably disposed in a small circle.

Fortunately this phenomenon was viewed attentively at New Haven, by Prof. Olmsted, of Yale College, who obligingly put into my hand the loose paper containing his minutes, made on the spot, from which I extract so much as relates to the phenomenon during the time of my own observations already detailed.

"3*m.* before 10—arch—northern margin grazed Arcturus. Vertex on the Arrow, Dec. 18°,—covered the Dolphin. Vertex advanced no farther south, but western limb moved to the head of the Serpent, where it remained stationary till 25 minutes after 10, and disappeared."

"Western limb bent, being convex towards the south."

"Northern margin well defined."

"Parallel ridges N. E. and S. W. two to four degrees asunder, like parallel drifts of snow."

By attentively considering and comparing the two sets of observations given above, and made at points twenty two miles asunder, we derive the following conclusions.

First. The *identity* of the arch seen by Prof. Olmsted with that seen by myself is proved by several coincidences: by the coincidence in the first place, as to the time of its formation,—it being, according to Prof. Olmsted, at 9*h*. 57*m*. P. M., and according to my own minutes at 9*h*. 55*m*. P. M. Again, by the coincidence in the time of disappearance, which was put by Prof. Olmsted at 10*h*. 25*m*., and by myself at 10*h*. 30*m*. Of course, the disappearance being gradual, there would naturally be some difference as to the exact moment, even if the watches of the different observers were just alike, which is not to be expected to a single minute, or perhaps more. My own time was carefully compared, on the following morning, with that of the clocks in New York, and all due allowances made to reduce it to time at New Haven. The faint reappearance of the arch after its first vanishing was not noticed by Prof. Olmsted. Further, there is a coincidence in the azimuthal position of the arches seen by both observers. In their first position, the meridian of both, it may be seen by a comparison upon the globe, cut the horizon at the same point—15 degrees *east* of north;* but in their final position this meridian, according to both observations, was shifted to a point several degrees nearer to the north,—yet all the while the entire arch was seen (as it ought to have been) in a more southerly position by the more northerly observer. Again, there was a coincidence in the remarkable phenomenon presented by the arch when it broke into parallel *fleeces*, as described by me, or *ridges* like parallel snow drifts, as described by Prof. Olmsted. Lastly, the arch being nearly over head to both observers, and the distance of the stations being only twenty two miles asunder, it is evident that if there had been two similar objects, and those even as low as the region of the ordinary clouds, both would have been visible to both observers. In fact however only one was seen by either. The combined force of these coincidences amounts to a *demonstration* of *identity*.

Secondly. The base line, although only twenty two miles long, was fortunately so situated as to subtend nearly the greatest possible angle and give nearly the greatest possible parallax. The arch was vertical within three degrees to its southern extremity, and the base itself varied in direction but a few degrees from the meridian of the observed arches. That part of the arch therefore which was the *vertex* to one observer, would be almost *identical* with the part which was the vertex to the other. Under these circumstances the upper parts of the arch, which were centered to Prof. Olmsted's view upon the *Arrow*, in N. Dec. 18°, were centered, to my own view, upon the star *Alpha Lyræ* in N. Dec. 38⅛°—showing a *reduced* parallax of 19⅔°, in the first position, and a height of *sixty miles* above the earth's surface. The parallax however appears to have been continually diminishing; for the vertex as seen by Prof. Olmsted was *stationary*, while the same, as seen by me, was constantly and progressively, although rather irregularly changing southward. This at first view perplexing circumstance involves no difficulty, except that it compels us to suppose that the arch had a *rapid upward motion*, which at the vertex was such as to coincide with Prof. Olmsted's line of vision; but which, being oblique to my own line of sight, would give an apparent southerly motion. This motion was so considerable as to reduce the final parallax to about 8¾°, and to increase the calculated final height to 144⅓ miles. In computing the latter height, the southern observer's change of place by the motion of the boat has been estimated;—and the base accordingly assumed at 25 miles S. 23° W. from New Haven. The results of these calculations are to be taken only as near approximations, in consequence of the impossibility of fixing exactly my own situation on Long Island Sound. They are, however, doubtless, near the truth, and are *complete* for the object of demonstrating the great height of the *region* in which this auroral arch had its formation, and its changes. This arch was narrow,—not more than three degrees in apparent breadth; yet that breadth cannot have been less, in absolute distance, than an equal number of miles. It was visible at the extremities not quite down to the horizon; yet the part which was in view to either observer, cannot be estimated in the lowest position of the arch at less than seven hundred miles, and in its highest position it must have equalled eleven hundred.

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* This determination was made, as before mentioned, from the *western* limb of the arch, the eastern would show its meridian nearer the north point, but still east of it by several degrees—say 11°.

Auroral Arch of May, 1836.

This appeared in the evening of May 8th. It has been mentioned by Prof. Olmsted in his memoir, published in the last No. of the Journal of Science. I had not myself the good fortune to witness it; but I have at my disposal the observations made at New Haven by Prof. Olmsted,—at Hartford, by Mr. P. W. Ellsworth, a late graduate of Yale College, and at Meriden by Mr. William Allen, an intelligent young man, and a member of my own engineer corps on the Hartford and New Haven Rail Road. I adduce these different observations, not to show the exact height of the object at any specific moment, (that height *may* indeed have been continually changing,) but in support of the main idea that it was elevated throughout far above the region of the ordinary clouds. With this purpose in view, I give in order the different observations, beginning with those of Prof. Olmsted.

By Prof. Olmsted the phenomenon was not seen until 9*h*, 55*m*. P. M. At that time the southern margin of the bow was seen resting upon the southern stars of the Northern Crown, while its northern margin lay along the tail of the Great Bear. It advanced southward until its south edge reached Arcturus, where it became stationary, and vanished at 10*h*. 10*m*.

Mr. Wm. Allen, being at Meriden, the half way point between New Haven and Hartford, saw the arch at its first formation. He was then riding slowly west, and witnessed the entire phenomena. Very soon after the formation of the bow the star Benetnasch, in the tail of the Great Bear, was in its southern margin; while Venus in the west was shining through it—and he thinks near its middle. The bow moved slowly south, and just before its disappearance separated into two parts,—one east and the other west of Arcturus, which then lay near the central line of the bow, while the star Mu Leonis was near its south edge. By the time he had ridden two miles the arch disappeared. This disappearance occurred a little after ten o'clock.

Mr. P. W. Ellsworth describes the arch as having begun to develope itself rapidly at half past nine, and soon afterwards passing from the east a little north of Corona, and extending as far as Castor; at 9*h*. 40*m*. the arch had advanced southward, passing through the Crown and south of Pollux, and at this period appeared most beautiful. In the east it terminated in an acute angle before reaching the horizon, resembling a column of white smoke. The arch had a milky appearance; it occasionally broke into waves, which advanced from the east with a rapid, regular motion, passing quite across to the west. These waves sometimes assumed a direction resembling the radii of a circle, but extended only a short distance from the arch itself. At 9*h*. 55*m*. the center of the luminous zone had reached Arcturus and the Sickle, and passing half across the Sickle suddenly disappeared at 10*h*. 5*m*. P. M. The light in the north assumed also the appearance of an arch, running nearly parallel with the other. It remained stationary, becoming now and then less distinct and again resuming its original brightness. A few faint beams of light radiated from the northwest towards the zenith; the sky was perfectly free from clouds, but was overspread with a thin veil of light rendering the smaller stars obscure. The weather was cool, with a wind due north.

In the comparison of the foregoing observations with each other, they manifest a consistency extending through every period of the bow's progress and duration. Thus, in the first stages of the bow, and very soon after its formation, Mr. Ellsworth, at Hartford, saw it lying north of the Crown and of Castor,—certainly at nearly the same moment when Mr. Allen, sixteen miles south of him in latitude, saw the same entirely north of Benetnasch, in the tail of the Great Bear. There would seem by this to have been a parallax of about half the breadth of the bow, or a little more—say 7°, to a base of sixteen miles. Again, in the middle stages of the bow, Prof. Olmsted, fifteen minutes before its disappearance, saw it passing through the Northern Crown, in a position certainly not varying widely from that assigned to it in the same constellation, by Mr. Ellsworth, twenty five minutes before the disappearance. The parallax, therefore, due to a base of thirty two miles would seem by this to be equal to the motion of the bow in ten minutes—say 12°. Finally, in the last stages of the bow, Prof. Olmsted saw it vanish when its south margin had just reached Arcturus, while Mr. Allen, sixteen miles north, saw its middle upon Arcturus "just before" the disappearance,—and while Mr. Ellsworth, still sixteen miles farther north, saw the same star in the same position relatively to the bow, "ten minutes"—before the disappearance. The parallax between the stations at New Haven and Hartford, would, by the last comparisons, appear to be something greater than the motion of the bow during the last ten minutes of its appearance, during a part of which ten minutes, according to Prof. Olmsted, it was stationary. The motion was about the same according to each observer—rather exceeding, in the average of all three, one degree to a minute. The breadth of the bow *in its middle stages*, appears by Prof. Olmsted's observations to have been about 12°. It is impossible, from the foregoing observations, to fix upon a definite parallax, although we may *approximate* to it with entire certainty. The observations are *perfect* in relation to the general object of the present paper—since the largest paral lax which could be assigned, consistently with the observations, would elevate the bow more than *one hundred miles* above the surface. Indeed, Prof. Olmsted has publicly expressed his own judgment as to the height of this bow at the time of his observations, which he makes as great as *one hundred and sixty miles*. The last, however, ought perhaps to be esteemed the *maximum* height which we are at liberty to assign. The meridian of this arch, like that of August, appears to have been directed to the east of north.

Dip of the Auroral Streamers.

In the brilliant aurora of Nov. 17th, 1835, a corona was formed at about 11 o'clock, P. M. Its position was, to my own view, in 23½° N. Dec. I made the observation at Berlin, in Lat. 41° 40′. Taking into view the position of the magnetic meridian, the dip, of course, was 71°, very nearly, at that place. The first corona of April 22d, 1836, at about midnight, was, to my view at New Haven, (lat. 41° 18′,) in 23½° N. Dec. It moved regularly north, and in three quarters of an hour, was in 25⅓° N. Dec. In one hour and a quarter more it had returned to 24° 10′. The average dip would be about 72¼°. Much the most definite observation of the kind I have been able to make was on the occasion of the magnificent display of Jan. 25th, 1837. The corona was then situated in Dec. N. 23¾°, and the dip was of course near 71½°.

I take this opportunity to relate the occurrence of a few optical appearances, which I have witnessed at different times, and which may deserve notice.

Supernumerary Rainbows.

In the latter part of September, 1823, being on the river St. Lawrence, and having arrived at Montreal just at sunrise, I noticed in the west a dark blue cloud, which came over rapidly. The sun was shining very brightly from the opposite quarter, and formed in the cloud a bow of remarkable vividness and completeness. The secondary was also complete, and nearly as distinct in all its colors as the primary commonly is. The primary, although vivid, was less cheerful than usual in its aspect; owing probably to the sombre shading of the cloud seen through it. The violet seemed darkened to a dull red. Under the primary, an arc of the same color with the interior of the primary, (i. e. violet, or rather a dull red,) extended parallel with it nearly through the arch. Then followed a second arc, still beneath, fainter and of but half the extent. Below this a third was just discernible. The successive intervals between the interior of the primary and the colored arcs were equal,—each being less than the breadth of the bow. It appeared to me that all were distinct bows lapping upon one another,—the single color above mentioned of the supernumeraries was however alone seen, leaving apparently an unoccupied interval upon each side of it; probably because the intervening colors—being some compound of blue—could but feebly contrast with the cloud itself. The other colors mingling with the superior bows and chiefly with the violet could not be perceived; except in enhancing the *dulness* of that color, already mentioned.

I have at other times seen a *single* violet supernumerary arch, sometimes *exterior* and sometimes *interior* to the primary, but nothing in the least comparable to the foregoing. I had imagined also that I noticed the same phenomenon in the spray at Niagara Falls.

So many supernumerary bows as existed in the case mentioned by me as being visible at Montreal, form a combination of rare occurrence. The writer of the article "Optics," in the Library of Useful Knowledge, relates the occurrence of the phenomenon to his own view with *four* successive supernumeraries,—the *red* of each lower bow mingling with the violet of the bow next above.* The cause of the phenomenon appears yet to be unexplained.

While on the subject of rainbows, I must not neglect to notice a remarkable attendant upon one of great beauty, which appeared at seven o'clock, A. M. on or about Oct. 25, 1836. From the southern extremity of this bow, and tangent to it where it met the horizon, there arose a vertical column of the same apparent breadth with the bow, and having its colors, according to my recollection, in the same order. The appearance was faint, but too indisputable to be classed as an optical illusion. It did not rise so high as to cut the secondary; indeed, at its upper extremity, it evidently began to have a deviation to the right or towards the primary. This phenomenon was witnessed by many persons in different situations, and was a subject of general remark at the meeting of the Connecticut Academy in the evening of the day.

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* Whether the supernumeraries seen by myself were *four* in number, or only *three*, would depend upon the question whether the colored arcs were to be esteemed violet or red,—a point respecting which I had expressed myself doubtfully in my minutes.

Halos in January, 1835.

Many years ago, on one excessively cold morning, there were seen, upon the plain of West Point, by persons looking towards the sun, upright columns of great splendor, and of prismatic hues, far exceeding in brilliancy any rainbow which had ever been witnessed by the individual who described this to me. Of this phenomenon I cannot give a more particular description; but it was, I presume, identical with the one which I am about to describe.

The morning of Jan. 5th, 1835, was excessively cold,—the thermometer having been before sunrise down to 16° below zero at West Point, where I then was. At a quarter before nine, A. M. I observed the air to be full of bright *spiculæ*, settling down upon objects like the hoar frost. Being instantly reminded of the foregoing spectacle, which had been formerly described to me, I went out of doors in search of something similar. The air was very calm and still—moving I should think a little from the north or northwest. Looking towards the sun, I saw at once on each side of him, for perhaps 30°, the arc of a halo, of which he was the center. The arcs might easily have been taken for upright columns. They were prismatic; the *violet* being *exterior*, and the *red* being *interior* or towards the sun. They were nearly vertical; the brightest parts being opposite the sun on each side, horizontally. I measured roughly the diameter of the halo, and found (taking the average of the colors) that it was just 45°. There was, in addition, a bright column, of the breadth of the sun, and not prismatic, which passed perpendicularly down from that luminary to the horizon,—or rather to the surface of the river, which was two hundred feet below me, and one quarter of a mile distant. This column was of the hue of sunlight, or twilight, but rather faint, as were also all the phenomena. There was at the time a smokiness in the air, like that of "Indian summer," which I took at first to be the effect of the floating spiculæ; but it continued visible just as plainly after they were gone. Indeed it continued all the day. At twenty five minutes past nine, I re-measured the halo with much care, although by rough means, and found its diameter as before, just 45°. This result was certainly very near the truth. Some time after this, its halo disappeared, although the spiculæ remained in the air. The column of light which passed up to the sun was not visible far, if at all, above it; but the luminous arches extended, I should say from recollection, as much above their brightest point as beneath.

Art. II.—*Geological and Mineralogical Notices;* by Oliver P. Hubbard, M. D. Professor of Chemistry, Mineralogy, and Geology, in Dartmouth College.

TO PROFESSOR SILLIMAN.

Dear Sir,—Enclosed are some observations, made two years since, during an excursion in the northern part of the State of New York, which are at your service, should you think them worthy of being recorded.

At Boonville, Oneida County, N. Y., the underlying rock of the country is the transition limestone, which has been heretofore described in its extent and outlines by Prof. Eaton, and I only wish to mention its appearance and character at this one point in the line of its direction from Trenton Falls to Lake Ontario. The surface, when the soil is removed, is found smooth, as if worn by attrition, but which may be owing to an equable disintegration produced by causes in constant action. Throughout the soil and on its surface are scattered large, thin, flat curvilinear masses of the same rock, which are also worn smooth. The rock is burned extensively for lime—is very hard, and being stratified in layers of moderate thickness, is easily quarried.

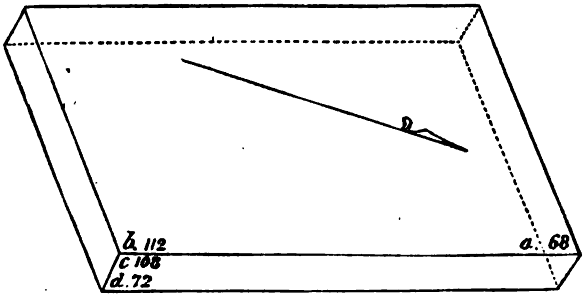
In the cliffs of the river banks, the layers are of variable thickness—when affected by the weather, they are quite thin, broken into small irregular blocks, and generally they are separated by a thin layer of argillaceous earth, like mortar in a wall. The upper beds appear entirely filled with petrifactions, crinoidea, terebratulæ, &c. interstratified occasionally with others, which contain no organic remains. These facts, with some other interesting features, may be conveniently observed on a stream in Leyden, Lewis Co., (about three miles from Boonville,) called “Dry Sugar River.” About a mile and a half from its junction with the Black river, it is compressed into a narrow, irregular, rocky passage, and makes a cascade of sixty feet or more into an expanded basin below—and at high water runs with a full channel to its mouth. The banks from the basin are probably eighty or one hundred feet high, and continuously form the western limit of the great valley of the Black river, which here gradually slopes on the west side of Dry Sugar river to an elevation of thirty or forty feet, and on the eastern suddenly declines to nearly the level of the water. At the common height of the stream, (as at the time of my visit,) there is not water sufficient to cover the whole channel from the fall to its mouth, and at half way between the two, the stream is engulphed in some fissures in the rock, and at a distance of two hundred yards issues again at the base of a small ledge and finds its way in an open and shorter current to Black river. The channel below this fissure is therefore perfectly dry. The rock in the wood near by, is cavernous, as indicated by the subterraneous passage of the river—by several small accessible caverns, with roof and sides formed of large confusedly congregated masses, and by a rumbling noise when a carriage is driven over the road—the structure of this part indicating the effect of a powerful disruptive agency.

In the dry bed of the stream the rock has a different aspect in several particulars from the superior strata as found in the cliffs—the fossils are madreporites, corallines, and orthoceræ, in great number, and the latter of large size imbedded and their upper half abraded by the current, but their septa, as usual, harder than their gangue, still projecting above its surface. These are from two to three feet in length; the siphunculus filled with calc spar, and the whole in some cases mineralized, as it were, by a hard, black limestone, with a conchoidal fracture.

All attempts to detach a complete specimen were futile, but my search was rewarded by finding loose the smaller termination of an orthocera, perfect in its external form—septa oblique to its axis—about eight inches long—diameters at the upper end five inches and three inches and a half—and circumference twelve inches and a half; and if the entire length were in proportion to these dimensions, compared with the specimens above cited, this one must have been many feet long.

The strata here are much thicker than those in the upper series, and the bed of the stream in its whole width, and for a quarter of a mile, is divided at various distances apart, by several parallel longitudinal fissures, which are not vertical, but have a considerable dip to the east and a direction as nearly as I could judge without a needle, N. by W. and S. by E. Obliquely these are intersected by other similar fissures—direction nearly N. E. and S. W., and dip S. E. nearly. The intersection of these, of course divides the rock into rhomboidal blocks, having *a double inclination*, whose sides are oblique angled parallelograms, and each opposite pair equal and similar. With two straight edged sticks, the only means at hand, I attempted, with the assistance of a friend, to measure the angles of intersection of the fissures, which were transferred carefully to paper, with the pencil, viz. *a*. 67½°, *b*. 111½°=179°; *c*. 107½°, *d*. 72°=179½°. Allowing for error in measurement of half a degree, we have the following result—to *a*. and *b*. and *c*. add half a degree, and we have *a.* 68°, *b.* 112°=180°; *c.* 108°, *d.* 72°=180°; from which was constructed the annexed figure. These measurements

Rhomboidal Limestone.



7 feet long, 5 wide, 1 thick.

were repeated on the same stone, and on different stones, and the angles opposite to them were also measured, and found to vary in no important manner, indicating a very remarkable regularity and parallelism of the opposite sides. Running across the stones in two directions, parallel to the sides, were distinct superficial cracks, and cleavage through them would cut the mass into many precisely similar solids; showing clearly, that the same cause that produced the main fissures, now by the running water, enlarged to inches in width, completely impressed its force and conferred a similar structure upon the whole. The dimensions of these rocks are very various, as may be seen by the measurement of some—ft. 1×1×6. 5×7×1—figured above, 4×6×24. This last, with the specific gravity of 2.5, must weigh 37½ tons.

The attention now paid to the structure of rocks by such observers as Conybeare, Sedgwick, De la Beche, and others, assures us of the importance of treasuring up every fact, and in its description descending to minute particulars, how little soever we may at present be able to appreciate them. I regret therefore that my time having been mostly devoted to the collection of minerals on that day, prevented definite observations on some collateral points of importance, as the dip, direction, &c. of the strata—though my impression is they varied little from a horizontal position.

This subject has excited new interest, and received new light from Mr. Hopkins' researches, reported to the late meeting of the British Association, and the facts constantly multiplying seem already to promise the induction of some important general law. The remark of Mr. Phillips that "the regularity of the structure (in the arenaceous, argillaceous, and calcareous rocks) increased with the antiquity of the rock," and "was well exemplified in the older slates and limestones," receives marked confirmation from this instance, as well as from the rhomboidal sandstone near Hartford, (Vol. XVII. p. 124.) Is there in these examples (the sandstone is without doubt calcareous) the result of an unknown or the modification of a known law analogous to crystallization? Is not the rhomboidal the more common of all *symmetrical* structures in stratified rocks? Facts, certainly, seem to lead to this conclusion.

Boulders.—An interesting and prominent feature in the geology of this region, and which cannot fail to attract the notice of every casual observer, is the numerous and immense boulders of primitive rocks, unlike any thing he would find here *in place*, which are scattered every where over the surface. They are principally of the granitic family—a red sienite prevails—masses of decidedly hornblende rocks—others composed entirely of white feldspar and glassy quartz—others still of grayish feldspar with brilliant cleavage-surfaces and crystals of mica and scales of plumbago.* One single boulder was discovered very much resembling the Labrador felspar—contained no quartz—but many small four sided prisms not unlike in external appearance to zircons. These are scattered upon the hills, accumulated in the valleys and the beds of streams, particularly of Black river, running north, and of Lansing's Kill, a branch of the Mohawk, running south. Boonville is the summit level of this region, being about six hundred feet higher than the level of the Erie Canal at Rome, and its waters part, descending north and south. The gravel hills cut through by the roads show the boulders buried throughout, twelve or fifteen feet from the surface. These and others found in the streams, as at the accumulations below High falls in Black river, bear the marks of long continued attrition, and are smoothed and rounded, while the larger ones on the surface, which from their size appear almost immovable, would seem from the freshness of their fracture and their salient angles, to have been simultaneously and by the same causes, separated from their original bed and transferred to their present position. The source of these rocks must be sought in the north and east, as none of their character exist probably south of this place in the whole state; this proves a northerly current, of which we have such decisive evidences in the boulders of New England and the western states. In Brown's tract, (a wilderness region lying northeast, richly stocked with game and filled with delightful lakes,) I am informed by those who frequent it for hunting, that the eminences are composed of rugged, primitive rocks covered with a hardy growth of evergreens. It is probable, from the investigations on the northwest and east near Lake Champlain, where the primitive rocks are found, that it is but a short distance from Boonville to the junction of the transition limestone with the earlier formations. In fact, all that part of the state north of the Mohawk and Black rivers is described in Maclure's sketch and map as primitive, although further examinations may modify this view; and if I mistake not, the bed of the Black river near Boonville is partly in granite, and the High falls are made by a granite ledge, or dyke—although as my recollection of these observations is indistinct, I would not assert them with entire confidence.

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* Since the above was written, I have received Prof. Emmons' Report on the geology of the northern part of New York. He finds in place rocks on a grand scale, of which the boulders here cited appear to be types, e. g. the red granite of the Kayederosseras range and at the Thousand Islands, containing beds of white felspar, and especially the "gray bluish green" felspathic rock that contains the Labrador felspar, and whose boulders are found in the valley of the Hudson in Orange Co., at Little Falls, and now at this place, and some thirty miles farther west and north.

New Locality of Calc Spar.—Information from a young farmer that "they found diamonds in his neighborhood," induced me to visit the spot he pointed out, expecting as usual to find fine crystals of quartz. It was on the western bank of the Dry Sugar river, and on clearing away a large quantity of earth and stones, several tortuous vertical cracks were discovered, six or eight feet long, in some parts of sufficient width to insert the hand, and filled with wet argillaceous earth, containing great numbers of loose imperfect crystals of calc spar. The face of the rock on each side of the vein was entirely covered with an incrustation of beautiful crystals. Their form is represented by figures 96 and 97, of Shepard's Mineralogy—the *equiaxe* of Haüy, with the lateral angles replaced by tangent planes variously produced—also figure 19, Pl. 3, in Cleaveland's Mineralogy. Some of the crystals are an inch in length—"six sided prisms with pentagonal sides, terminated at each extremity by three pentagonal faces, which stand on alternate lateral planes, and form with them an angle of 116° 34′." The rock is very hard and divided into layers of from two to twelve inches, and it requires much labor and care to extract the specimens without injury.

Green Coccolite.—Large boulders of green coccolite and glassy quartz, in about equal proportions, are found interspersed with those of granite in Boonville and Leyden, and when laid up in the farm walls, with the fresh fracture exposed to view, the pieces have a most beautiful appearance. I have found pebbles of this kind in the Mohawk at Rome, and at the foot of High falls on Black river—thirty five miles apart.

The coccolite, of a deep green color, occurs in masses of large granular concretions, and in grains disseminated through the quartz, presenting in its fracture, brilliant cleavage faces, partially developing the primary form. The coccolite encloses rhomboidal calc spar of various hues; and on blasting to obtain unweathered specimens, the rock opened through several veins of *Tabular Spar,* which remained on either face, coating it with a thin layer of most delicate whiteness. Crystals of prismatic *green pyroxene,* an inch in length, were observed in one instance.

In a large boulder, (near the road on the right, just before entering the village of Boonville from the south,) some thirty feet in circumference, and eight or ten feet in height, were several veins of white feldspar and quartz, from two to five inches wide, intersecting each other and extending through the rock, which contained in profusion the *brown granular garnet,* and a few points of the green coccolite. These minerals were noticed in Vol. XIII. p. 198, and richly deserve for their beauty the high encomiums there bestowed; and the fact last mentioned illustrates the uniformity which prevails in the associations of minerals, being the same as found at Willsboro' and other places.

Art. III.—*On the Economical Uses of some species of Testacea.*

(Concluded from No. I. page 73.)

VI. Murex ———? (Linn.)—Hebrew *Argaman.* Greek *Πορφυρα,* and Lat. *Purpura.* *Purple Whelk.*

What the species was from which the ancients obtained the real Tyrian dye, is now uncertain, but in coloring cloth there is no doubt that many species, and perhaps two or three genera, were used. The *Murices,* the *Buccina,* and the *Strombi,* and probably most of the voluted univalves, contain more or less of the coloring matter, and we may reasonably suppose that they would not be neglected where there was so great a demand for the purple dye. By the old writers, however, they are all described under one name. Pliny makes mention of two species, from one of which only the true color was obtained; the other (which he calls *Conchylium*) seems from his description to have been a real Buccinum, and produced only a poor blue or greenish hue, like the sea in a storm, while it emitted a strong rank smell, and was of course less valuable. The shell dye has been in use from the earliest periods. Moses, B. C. 1491, makes mention of it in several places, and he used much wool of a purple color in the works of the tabernacle, and in the garments of the High Priest.[*] This the Israelites must have brought out from Egypt with them, and from the quantity in their possession it cannot have been very scarce in that country. It was used as royal robes by the kings of Midian, B. C. 1249;[†] and B. C. 606, the Babylonians covered their idols with garments of purple.[‡] At the same time it was also the royal color among these people, and we find that Daniel, after explaining the writing on the wall, as a special mark of favor, was clothed in it.[§] Alexander Balus, king of Syria, sent Jonathan Maccabeus a crown of gold, and a purple robe, allowing him to take the title of king's friend.[||] The band or Cydaris, which formed the essential part in the old Persian diadem, was composed of a twined substance of purple and white; and any body below the royal dignity presuming to wear these colors, unsanctioned by the king, was guilty of a transgression of the law deemed equal to high treason.[¶]

Although in after times it was almost exclusively known by the name of Tyrian purple, yet it appears to have been only on the decline of that great commercial city that it was manufactured there. It is mentioned by Ezekiel,[**] B. C. 588, as being imported from the Isles of Elisha, (Peloponnesus;) and Aristotle,[††] as late as B. C. 340, makes no mention of its being brought from Phœnicia. In his time the best and largest shells were from Sigeum and Lectum on the promontory of Troas, and the smaller and inferior from Euripus and Caria. When, however, Tyre had lost its commerce, and become an inferior place, the chief supply of Europe was drawn from it, though we find it imported into Rome from Lacedemon, and manufactures of it in various parts of Italy as late as A. D. 14.[‡‡] During the earlier periods of the Roman republic it was solely worn by the kings and patricians, but in later times Pliny[§§] informs us that cloth of this color was so common as to be employed as tapestry, and for the covering of furniture, by all the better class of citizens. He also remarks, that so great was its antiquity that the introduction of it was unknown to him, and adds from the chronicles then extant, that Romulus and his successors used it—which was perhaps only the same as saying that the first invention of it could not be traced. The Grecian tradition, but which of course was merely a fable, was that Hercules Tyrius was the first discover of it, his dog by chance having eaten the shell fish, and returned to him with its lips tinged with the purple color. Da Costa imagines that the dying qualities of the periwinkle (*Buccinum Lapillus*, Linn.) were known to the ancient British, and quotes the authority of the venerable Bede, who lived (on the sea coast) in the early part of the eighth century.[*] Among the Greeks, Lycurgus ordered the Lacedemonians to clothe their soldiers with scarlet, [*purple;*] the reason of which institution seems either to have been because this color is soonest imbibed by cloth, and most lasting and durable, or on the account of its brightness and splendor, which the lawgiver thought conducive to raise the men's spirits, or lastly, because it was most proper to conceal the stains of blood. In war, a purple garment was frequently placed on the end of a spear and used as a flag or signal.[†]

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[*] Exodus xxv. 14. xxviii. 5—6. Josephus, Act. Jud. lib. iii. c. vii. § 7.

[†] Judges viii. 26.

[‡] Jeremiah x. 9. Baruch vi. 12.

[§] Daniel v. 7.

[||] Maccabees i. 20. These references are from Calmet's Dictionary, Art. PURPLE, where they are distinctly understood to refer to the dye from the shell.

[¶] Sir Robert Ker Porter's Travels in Georgia, &c. Volume ii. p. 154, *quoted in* Horne's Introd. to the Holy Scriptures, Vol. i. ch. iii. sec. 3. § 3.

[**] Ezekiel xvii. 7.

[††] Aristot. de Hist. Animal, lib. v. cap. 15.

[‡‡] Macpherson's Annals of Commerce, Vol. i. p. 124. Juvenal, Sat. viii. 101.

[§§] Plin. Hist. Nat. lib. ix. cap. 36. lib. xxxi. cap. 10. from which all the information with respect to the Romans is drawn, where not otherwise pointed out.

And though Jesus Christ was clothed in purple before his crucifixion, as a mark of derision, yet at this time it does not appear to have been either universally or necessarily worn by princes. Herod, when giving audience to the ambassadors from Tyre and Sidon, is described as being dressed in "*royal apparel*," which was not purple, but, as Josephus tells us, was wholly of silver.[‡]

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[*] "*Sunt cochleæ, satis superabundantes, quibus tinctura coccinei coloris conficitur; cujus rubor pulcherrimus nullo unquam solis ardore, nulla valet pluviarum injuria pallescere, sed quo vetustior, eo solet esse venustior.*" Bede, Hist. Eccles. lib. i. cap. i. See Donovan's British Shells, in loco *B. Lapillus*. It is to be remarked that Bede lived at Jarrow, about five miles from the mouth of the river Tyne, which there divides the counties of Durham and Northumberland, and the rocks on that coast at the present day abound with this shell: indeed, so plentiful are they, that it may almost be said that acres of rocks are hidden from sight by the clustering of the fish, intermixed with the *Balanas elongatus*, (Mont.) and young of the *Mytilus edulis*; and the supply is quite sufficient to have served for an extensive manufacture of the dye.

[†] Potter's Archæologia Græca, 6th ed. vol. ii. p. 50.

[‡] *Ενδυσαμενος 'εσθητα βασιλικην.* Acts ch. xii. ver. 21. *Στολην 'ενδυσαμενος εξ αργυρου πεποιημενην ΠΑΣΑΝ.* Josephus, Ant. Jud. lib. xviii. c. 8. § 2.

The shells inhabit all the shores of the Mediterranean, but the best were procured at Tyre, the island of Meninx, the coasts of Getulia and Laconica, and the island of Coa in the Ægean Sea.* The real Murex was fished for and caught with small and delicate nets; a bait was put in them, consisting of cockles or other bivalves, which had been so long kept out of water, that on being thrown in again they gaped widely. The Murex attacked them as food, and was drawn up with them. The other species were found adhering to rocks, on mud banks, &c. The season for catching them was in the spring, when the dye was the deepest and best. It is contained in a small white vein, which lies in the neck of the fish, and in its natural state is a thin and almost colorless liquor. The shell was carefully broken off, and as the dye loses its value when the fish is dead, they were obliged to cut it out alive. The veins were then laid in salt, and left to settle for three days; after which the whole was boiled for ten days more, and the fleshy parts skimmed off as they rose to the surface, till the whole liquid was clear, bright and red. The longer it was boiled, the deeper of course the color became. After this, the wool, well scoured, was steeped in it for some hours, then cleaned and carded, and put in again, to remain till it could absorb no more. Nitre was employed in fixing the color. The hue of the Tyrian dye was of a very deep red, soft and shining; the color of a rose, but approaching to black, or like a very deep shade of the color now called *lake;* of course the word *purple* as at present understood, conveys a wrong impression. When the smaller and inferior species were used, the process was the same, with the exception of their being crushed in the shell, instead of the vein being cut from them. The two were occasionally mixed to produce a variety of shade, according to the fashion.† No mention is made of linen being so dyed, and it seems to have been confined to woolen fabrics, and perhaps, as some think, to cotton. A writer in the Philosophical Transactions of the Royal Society of London,‡ Anno 1684, mentions a person at Minhead, on the coast of Ireland, who made it his business to mark linen with the liquor from shells. From the description and plate given, he appears to have made use of the common periwinkle (*Buccinum Lapillus*, Linn.) for this purpose. On trying the experiment himself, the writer found the color to vary much, and frequently before attaining its final hue. At first it was pellucid and nearly colorless, then became a light green, and if placed in the sun, immediately much darker; in a few minutes it changed to a full sea green, and after that into a watchet blue; in a few minutes more it was a purplish red, and after lying an hour or two became a very deep purple. Further than this the sun did not affect it, but on being washed in soap and water it changed to a very bright and brilliant crimson. When the article dyed with it lay in the sun, it emitted a very strong and fetid smell, as if garlic and assafœtida were mixed together. More lately a species of shell was used by the Spanish Americans at Nicoya, also for dyeing with, but the cloth thus prepared was so expensive as only to be worn by the nobles.* Among the Romans the royal edicts were frequently signed with this liquor, and it was used as a pigment by artists.

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* Plin. Hist. Nat. and Juvenal Sat. ut supra.

† This appears to be the *dibaphos* and *bistinctus* of the Latin writers, and which does not imply that the wool had been twice dyed in the same liquor to produce a deeper shade, as some suppose, but that it was of an entirely different hue. Pliny says such was the most fashionable and the most expensive.

‡ Trans. of the Royal Society, abr'd. vol. ii.

In common with the rest of the genus, the fish is carnivorous and locomotive, living sometimes in deep water, and sometimes burying itself in the shore, while it is constantly searching for food. The coloring liquor is probably provided as a means of defense to the animal, as the ink of the cuttle fish, or the saliva of the snail; and although we have never observed the fact in any American or British species, the fish when touched is said to have the power of voluntarily emitting it.† In which case it comes out purple, and of a very rank and offensive odor. If this be so, it must undergo some change in passing through the vein, as when cut out it is white, and long in attaining its purple and final hue. Since the discovery of America, and the introduction of cochineal into Europe, the fish dye has been entirely neglected as an article of merchandise, and is not, that we are aware of, any where used in the present day.

VII. MUREX TRITONIS, (Linn.)—*Trumpet Shell.*

This fine univalve is indigenous to most warm climates; it inhabits the African, American, and Asiatic seas, and is found on the coasts of the islands of the southern Pacific. The only use it appears to be put to, is the making of musical horns or trumpets of it, and for this purpose it has long been used by the natives of Africa and India, and even long before the christian era it was thus employed by the inhabitants of the countries bordering on the Mediterranean. By the ancient Greeks it was universally used for giving signals in war. On the discovery of the Society Islands, it was found to be used in war, by the native priests on solemn occasions, and by the heralds in their ships; it was, in fact, the royal and religious instrument of music, and only made use of as such. The largest shells were selected for the purpose, which in general are about one foot in length. They made a perforation about an inch in diameter, near the apex, and into this they inserted a bamboo cane about three feet in length, which was secured by binding it to the shell by fine cocoa nut braid. The whole was made air tight with the gum of the breadfruit tree. The sound is described as being extremely loud, but the most dismal and monotonous that it is possible to imagine. As late as the last century it was used on board of ships trading to the West Indies or South America instead of a speaking trumpet. A species was also used (and perhaps still is) in Barbadoes, but whether the present one, we cannot from the description determine; it served instead of a bell to call the slaves to their work, and sounded so loud, that on a calm morning it might be heard above a mile off. The apex was merely broken, and then blown through. The fish was eaten, and divers were regularly employed in catching it. They were generally met with in about six fathom water, but after heavy rains they were found at the mouths of the water courses, feeding on the garbage washed down to them. If the water was dimpled so that the bottom could not be seen, the divers poured a spoonful of oil on the surface, which calmed it sufficiently for their purpose. When the tail part, which was somewhat gritty and sandy, was taken away, the rest of the fish tasted like "tripe, but shorter, sweeter, and more luscious." It is this shell which is generally represented in the hands of Triton in pictures, and whence its trivial name;* and from the use to which shells were thus put, originated the word *Buccinum*, which among the ancients included at least a third of the known univalves.*

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* Rees' Cyclopædia. Article PURPLE FISH.

† Aristotle, de Hist. Animal. lib. v. cap. 15. Hughes' Nat. Hist. of Barbadoes, p. 272.

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* Thus Ovid, speaking of Neptune—

—"supraque profundum
Extantem, atque humeros innato murice tectum
Cœruleum Tritona vocat, conchæque sonaci
Inspirare jubet, fluctusque et flumina signo
Jam revocare dato, cava buccina sumitur illi
Tortalis in latum quæ turbine crescit ab imo."

Ovid, Metamorph. lib. I.

VIII. Murex ——— ?

Another species of Murex (?) was used by the Greeks in preparing a pigment for painters; but the color was obtained from the outside of the shell, and not from the fish, as was the purple dye.†

IX. Ostrea edulis, (Linn.)—*European Oyster.*

Ancient History.—The oyster has probably been used from the earliest periods. As they lie in comparatively shallow water, quickly increase in numbers and size, and offer a very nutricious and refreshing food, we may reasonably suppose that the aborigines of those countries where they are found, were in general well acquainted with them. From Aristotle we learn that the Greeks in his time ate them.‡ It was as early as A. U. C. 633, that the mode of fattening them by laying them in pits and ponds was introduced to Rome. At that time, one Sergius Orata first tried the experiment on the Lucrine oysters, and as he made much money by it and his plan succeeding well, it rapidly spread into different districts. As Rome increased in luxury, the supply from the immediate coasts was not sufficient, and all the shores of the Mediterranean were ransacked for the shell fish. They were frequently brought from a great distance, and at much expense, to be fattened in Italy for the Roman feasts. They abounded at Abydos on the Hellespont;§ but the most celebrated appear to have been procured at Circæum, the Lacus Lucrinus, and from Brundusium. Much however of the fame of these places appears to have arisen from fashion, as we find writers of different times praising as the best those from different districts. The most generally esteemed, however, seem to be those from Rutupiæ, (now Sandwich, in Kent, England,) and which were carried to Italy in great numbers. If we consider the difficulties of land carriage, and the slowness of sailing vessels in those times, we may form some idea of their price, and the height to which luxury in eating had attained. In later times they appear to have been chiefly used for supper.* That many different species were used is probable. Pliny informs us that those from Circæum (Cape Cieceji) were black both in the flesh and shell, those from Spain reddish, and those from Sclavonia brown and dusky.† It was supposed that the fish fattened during the full moon, and grew thin as it waned; we are not aware that this has been observed in the present day, but it may have happened in particular situations, owing to the difference in the tides. The Roman epicures were in the habit of icing them before eating them, and the ladies used the calcined shell as a cosmetic and depilatory. To the doctors this fish was most valuable, being recommended in a great variety of diseases, and prepared in various ways; and though it could, generally speaking, do no good, it certainly could do little harm.

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* Dillwyn's Des. Cat. Vol. ii. p. 727. Plin. Hist. Nat. lib. xxxii. cap. 11. Ellis' Polynesian Researches, Vol. i. p. 197, where a wood cut of the instrument is given. Hughes' Nat. Hist. of Barbadoes, p. 276. Potter's Archæologia Græca, Vol. ii. p. 79, where there is given a long dissertation on the time in which real trumpets were introduced instead of the shells.

† "Concha quæ pictoribus usui est crassitudine plurimum excedit, at florem illum non intra tectem, sed foris habet." Arist. de Hist. Anim. lib. v. cap. 15. *Interpr.* Du Val, tom. ii. p. 844.

‡ Aristotle de Hist. Animal. lib. v. cap. 15.

§ Virgil, Georg. i. 207.

Modern History.—In England, the oyster fisheries are chiefly carried on at Colchester, in Essex, celebrated for its *green* oysters, at Feversham and Milton in Kent, and in the Isle of Wight. They are also fished for in the Swales of the Medway, in the Tenby on the coast of Wales, and near Liverpool, as well as around Portsmouth, and in many of the creeks of the southern coast. The best are found at Purfleet, the worst near Liverpool. They are very plentifully but partially distributed, and are found to extend further north on the western than on the eastern side of the island. In Scotland they also abound but appear likewise to prefer the northeastern to the northwestern coast. While they are every where plentiful and highly flavored, from the Clyde to the Zetland, Orkney, and Western Islands, it does not appear that they breed higher on the other side than in the Firth of Forth. Those on the western shores are however comparatively little used, and with the exception of a few sent from Loch Farbert to Greenock, they are consumed by the natives on the spot. Those of the eastern coast, on the contrary, are carried to Newcastle upon Tyne, Hull and London, and have been exported in large quantities to Holland. The best are procured near Preston Pans, Port Seaton, and the Isle of Inchkeith, in Musselburgh bay, Firth of Forth; and vessels from Milton, Lee, and other parts of England come to dredge for them, and carrying them away, afterwards fatten them for the English markets. Those from Preston Pans are known by the name of *Pandoors*, as being found at the door of, or near the pans, and from the quantity of fresh water are the fattest and best flavored. In Ireland, Milford Haven is celebrated for its oysters.

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* Juvenal, Sat. vi. 301.

† Plin. Hist. Nat. lib. ix. cap. 32.

Oysters are found on most parts of the French coast, but they are most plentiful on those of Bretagne and Normandy. The most extensive fishery is that which is carried on at Granville, in the bay of which, and for six leagues to the northward they abound. The fishermen bring them to the town and dispose of them to women, who after having fattened them, dispose of them, either pickled or in the shell. Paris, Dieppe and Rouen are chiefly supplied from this place, for which purpose boats are continually arriving from other parts. The oysters from Rochelle and Bordeaux, and generally from the coast of Bretagne, are however by far the most esteemed; being fatter and more highly flavored, owing to the quantity of fresh water there running into the ocean. Here they are *greened* in the same manner as in England, and require about the same time to come to perfection. They are all to be met with in Paris, but those from Normandy in the greatest numbers. The appetite for shell fish of all sorts, which seems peculiar to the natives of the southern provinces of Italy, is such as to appear exaggerated to a foreigner, accustomed to consider but a few of them as eatable. So great however is it, that at Taranto, the government draws a revenue of twenty four thousand ducats annually from the shell fishery alone. In the Mare Picolo, on which this place is situated, the spawn of the oyster is received on large conical earthen pans, secured at equal distances by ropes tied to them and sunk in different parts of the bay. Their appearance is equally singular and beautiful; the vessel becomes entirely hidden by the shells, when the whole assumes the form of one solid but irregular mass of rockwork. The young oysters being rubbed off are scattered through various parts of the bay, and finally, when sufficiently grown, are collected by means of iron rakes.

Of the quantity of oysters consumed in England, we have no certain or continuous statistics. In 1824, the quantity bred and taken in the county of Essex, and consumed mostly in London, was supposed to amount to fourteen thousand or fifteen thousand bushels. They are at times imported in considerable numbers, but the yearly quantity is subject to important fluctuations. In the season of 1801-2, one hundred and eighty eight British vessels, carrying from six to nine men each, were entered at the custom house of Cancale, in France, and carried back one hundred and nineteen millions four hundred and seventy three oysters, chiefly to London. On an average of 1831—1832, the imports into the same city amounted to fifty two thousand and ninety five bushels a year. In or about 1786, Glasgow consumed twenty thousand annually, which were carried from Leith on horseback or by carts, across the country. The quantity in the present day must be much greater. In 1803, the consumption of Paris was estimated at one million dozen, selling on an average at six sous per dozen.

Natural habits.—The European oyster is smaller, thinner, and more rounded than the American, while the lower valve is less concave or vaulted, it is not beaked, and the fish, compared with the size of the shell, is smaller and of a different flavor; there are besides, various other differences, and their habits are so very dissimilar that there can be no doubt at all of their being distinct species. The European oyster is found only adhering to rocks and stones, or occasionally to very strong clayey bottoms, and should these be washed away, the oyster beds perish. The fish is viviparous, and the young produced with a perfectly formed shell. They are, when first emitted, quite transparent, and they swim with great quickness, by means of a membrane extending out of the shell. So small are they in this state that Van Leeuwenhoek computes that one hundred and twenty of them in a row would extend an inch, and consequently a globular body, whose diameter is an inch, would, if they were round, be equal in size to one million seven hundred and twenty eight thousand of them! The vulgar opinion, and that on which the restraining laws have been framed is, that the period of spawning is May, at which time the young, or *spat*, is found adhering to the rocks. But as the young, as described above, are found in the parents perfectly formed and alive in the month of August, this is most probably the period of parturition, though it be not till May that they become fixed or sufficiently grown to be seen by the common observer. At this time they are about the size of a sixpence, and comparatively hard and firm, and have been well compared to a drop of candle grease in water. In two, or at farthest three years, they are fit for the table. The age to which it attains is probably great, but after having arrived at its full size, the valves are thickened, instead of being increased in length or breadth. From May to July, both the male and female oyster are said to be *sick*, and are in thin and poor condition, but by the end of August they have again recovered, are fat and in season. The sexes are distinguished by the fishermen, by the color of the fringe, that of the male being black, or dark colored, that of the female white. Sand is prejudicial to them, a mixture of fresh water advantageous. The shell, according to Mr. Hatchett, is formed of carbonate of lime and a great proportion of animal gluten, but more intimately mixed, and not lying in regular layers, as in the perlaceous shells.* The oyster frequently contains shining intestinal worms, or animalcules, which may be seen by opening the shell in the dark. A most destructive animal in an oyster bed is the sea-star, (*Asterias glacialis*, Linn.) which clasps its rays round the shell and perseveres till it has sucked out the inhabitant. Another enemy is said to be the muscle, (*Mytilus edulis*, Linn.)

Fishery.—In both England and France the season for fishing for the oyster is restricted by law. In the former country the time allowed for collecting the spawn from the sea is May, when the dredgers may take all they can procure, but after that month they are liable to be convicted of felony if they disturb it, and are only allowed to take such oysters as are the size of half a dollar. The spawn, or *spat*, as it is technically called, is dredged up, and if not too small, they separate it from the shells and stones to which it is adhering, and these they are obliged again to throw into the water to prevent the beds being destroyed. The spat is thrown into creeks or into shallow water on the shores, to increase in size and fatten, and in such situations is considered private property. At Preston Pans the oysters are not *bedded*, but are entirely procured from the sea, and in dredging, those which are too small are thrown back again. The season begins on the first of September, and lasts till April. The dredgers make use of a peculiar kind of net, which is very strong, and fastened to three spikes of iron; this they drag along the bottom of the sea, and thus force the oysters into it; each boat requires five men, and they dredge in water from four to fifteen fathoms deep. The *green* oysters are all procured at or in the neighborhood of Colchester. When they wish to give them this color, they throw them into pits dug about three feet deep in the salt marshes, which are overflooded only at spring tides, and to which they have sluices to let out the salt water till it be about one and a half feet deep. These pits become green, and communicate their color to the fish in four or five days, although they commonly let them continue there six weeks or two months, in which time they will become a dark green. The color has recently been ascertained to arise from confervæ, and other marine vegetable matter, decayed by the heat of the sun, on which the animal feeds. A very common and very mistaken opinion exists, especially among foreigners, that not only those, but all English oysters are impregnated with copper, '*which they get from feeding off copper banks*;' such we believe would be quite as injurious to the animal itself as it could be to us, and the fancy can only have arisen from the strong flavor peculiar to this fish. Green oysters are comparatively little esteemed in the present day.

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* Professor Rogers doubts the accuracy of this analysis, as regards the quantity of animal matter contained in this shell, and he supposes that there only exists a very minute portion of gluten. In this opinion he states that he is supported by the experiments of Bucholtz and Brandes, and those he himself made on the *Ostrea Virginica.* What the shells were which were used by the former gentleman, we are not informed; but with all deference we would suggest that he himself seems to have forgotten that the American and British shells are quite distinct species, from which most probably arises the difference he has discovered, and which instead of proving Mr. Hatchett's experiments to be in the main incorrect, only tends to prove that the species are perfectly distinct, and not mere varieties. The quantity of gluten contained in the *Ostrea edulis*, is well known to even the most superficial observer, where the shell is common, and may be found in the large and thick specimens, or on the decaying of the shell, between the inner and outer laminæ, frequently in great quantities. It is of a dirty yellow color, and thick and clammy in its consistency. See Silliman's Am. Jour., Vol. xxvi. p. 361.

Use.—The great value of this animal is for diet. The shell was at one time supposed to possess peculiar medicinal properties, but analysis has shown that the only advantage animal carbonates have over those of the mineral kingdom, arises from their containing no metallic or foreign substance.* The inhabitants of the shores of Hindoostan did, two centuries since, and perhaps still may, use it in the same manner. The fish is recommended by the doctors where great nourishment and easy digestion are required, the valuable quality being the quantity of gluten it contains. In the northeastern parts of England, old houses may be seen with their tops and gable ends ornamented with these shells, only the inside being exposed; a custom which is said, we know not with what truth, to have been introduced from Holland. In some parts of Scotland the shells are used as manure, and found very excellent and stimulating; in other places they are burned as lime.

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* Iodine is found in some of them.—*Ed.*

In 1768, Mr. John Canton discovered that a very good phosphorus* could be made from oyster shells. He added a little sulphur to them, and by calcination produced the substance. A long account of the process and his experiments is given in the Philosophical Transactions of that year. The French have a proverb drawn from this animal, which they apply to an awkward person, "*il parle ou joue, &c. comme une huitre á l'écaille.*"†

Besides these, oysters are found in most countries; the following are a few of the species.

The West Indies have, according to Hughes, two oysters, a large one in deep water, which is seldom eaten, and the mangrove oyster, which adheres to the roots of the trees in the wash of the tide, whence the old fable of oysters growing on trees. The same are found in Sumatra, where we are told that they are by no means so good as those of Europe.‡ Round the shores of New South Wales oysters are extremely plentiful, and though generally small, are of delicate flavor. Every rock is covered with them, and Mr. Martyn informs us he has seen parties of young ladies, with small hammers, seated on a large rock and feasting with great *goût* on these dainties.§ In Southern Africa the oysters of Mossel Bay are much celebrated, and their flavor considered so fine, that epicures have been induced to visit the bay from Cape Town, (Cape of Good Hope,) for the express purpose of enjoying a feast of them. The distance is about three hundred miles, so that they ought to be good to repay the trouble.‖

X. OSTREA SCABRA, (Linn.)—*Scaly Oyster.*

This is an inhabitant of the Bahama islands, where it is eaten. It is occasionally to be met with in the Philadelphia markets for the same purpose.

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* So called from its emitting light in the dark after exposure to the sun's rays.—ED.

† In compiling this article, the following works are those which have chiefly been referred to and quoted from:—Plin. Hist. Nat. lib. xxxii. cap. vi. lib. ix. cap. 36. Rees' Cyclopædia, Art. OYSTER. McCulloch's Comm. Dict. Art. OYSTER. Brewster's Edinburgh Encyclop. Art. FISHERIES. Encyclop. Americana, Appendix, Vol. viii. Art. OYSTER. Postlethwaite's Diction. Art. OYSTER. Sinclair's Stat. Hist. of Scotland, Vol. i. p. 358. Vol. vi. p. 196. Vol. x. p. 202. Vol. xvii. pp. 69, 102, &c. Keppel Craven's Tour, p. 184. Statistique generale, &c. par. P. E. Herbin, Vol. i. p. 386. Diction. de Trevoux. Philosophical Transactions, Vol. viii. 554. lviii. 337. ii. 606, &c. &c. &c.

‡ Marsden's Hist. Sumatra, p. 121.

§ Martyn's Hist. of the Br. Col. Vol. iv. p. 295.

‖ Webster's Voyage to the S. Atlantic Ocean, 1830, Vol. i. p. 223.

XII. Mya Pictorum, (Linn.)—*Painters' Gaper,*

Is common to many of the rivers of Great Britain and the north of Europe. It was formerly made use of for holding the colors employed by artists, whence its trivial name; but for the last thirty or forty years it has, we believe, been entirely neglected for this purpose, and is now only to be met with in collections.

XII. Turbo littoreus, (Linn.)—*Whelk.*

This shell is common to most of the shores of Great Britain, but is perhaps most plentiful on the limestone rocks, on the northeastern coast of England, where it lives in common with the periwinkle, below high water mark: it is gathered by children and old men, and retailed, boiled, in small measures, in the streets of the seaport towns. They are never very abundant, and may be considered rather as an humble luxury than an article of food.

The periwinkle, (*Buccinum Lapillus*, Linn.) though so nearly resembling it, and more common, is not, that we are aware of, ever used in the present day, though it formerly was, as Holinshed tells us: "We have in like maner no small store of great whelkes and perewinkles, and each of them brought farre into the land from the sea coaste in their severall seasons."*

XIII. Pecten maximum, (Penn.)—*Great Scallop.*

This shell is found on most of the coasts of Great Britain and Ireland, particularly on those of Portland and Purbeck in Dorsetshire, and near Yarmouth in Norfolk. The fish is eaten, and in some parts it is pickled and barreled, and in this state is the object of a small commerce. Holinshed mentions them as being extensively used in Henry VIII. and Queen Elizabeth's reigns, and they are still cooked in various ways, and considered a luxury. The fish was formerly supposed to be medicinal, and recommended by the doctors as "detersive, aperitive and carminative," and the shell was also administered in the same manner as that of the oyster. At a still earlier period it was worn by pilgrims, and thence found its way into armorial bearings.* It was, however, properly speaking, peculiar to the Compostella pilgrimage. Popes Alexander III, Gregory IX, and Clement V, granted in their bulls a faculty to the archbishop of Compostella, that they might excommunicate those who sold these shells to pilgrims any where except in the city of Santiago; and the reason assigned is, that the scallop shell is the badge of the apostle of Santiago or St. James.† They were occasionally carved as cameos. The shell lies in large beds, in moderately deep water, and is procured by dredging. In common with the other species, they are locomotive, and have the power of springing or leaping, by which they move themselves. They effect this by suddenly forcing the under valve against whatever they lie on, and so raise themselves a few inches at a time. The only value which the shell has now, is for its occasional, but well known use as a substitute for a dish.‡

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* Holinshed's Chronicles, Lond. Ed. 1807, Vol. i. p. 378.

XIV. PECTEN OPERCULARIS. (Penn.)—*Small Scallop.*

This shell, though smaller and less common than the former, is occasionally used as food on the southern coasts of England. Its habits are the same as the last, and the shell is not put to any use.§

XV. PECTEN CONCENTRICUM, *American Scallop,*

Is found along the whole coast of the United States, from Maine to Florida. It does not appear to be very generally used as food, but is occasionally to be met with in the New York markets and oyster cellars for that purpose.

Of this genus many more species are most probably used as food in different countries, as when large enough they are always easily obtained, wholesome and palatable.

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* "The scallop shows in a coat of arms,
That of the bearer's line,
Some one in former days hath been
To Santiago's shrine."—*Southey's Pilgrim. Introd.*

† Southey's Pilgrim. to Compostella, Notes, pp. 208—217, where various traditions of the origin are given.

‡ Donovan's Br. Shells, pl. 49. Holinshed's Chron. Vol. ii. p. 378, and James' Medical Dictionary, Vol. iv. Art. PECTEN.

§ Murray's Encyclopædia of Geography, Art. ENGLAND. Transactions of the Linnean Society of London, Vol. viii. p. 99.

XVI. VOLUTA GRAVIS. (Linn.)—*Chank.*

These shells form a considerable article of trade in Hindoostan, where they are in extensive demand all over the country. They are sawed into narrow rings, and are worn as ornaments for the arms, legs and fingers, by the Hindoo women. Many of them are likewise buried with the bodies of rich and distinguished persons. They are fished up by the pearl divers in the Gulf of Manaar, and elsewhere in India, in about two fathoms water. The fishery is monopolized by government, who most commonly let the banks for as much as four thousand pounds sterling per annum, but the trade is free. When the Dutch held possession of Ceylon, the fishery was open to all, but the trade to Bengal was a monopoly in the hands of the Company. A chank, opening to the right, called in Calcutta the *right handed chank*, is so highly prized as sometimes to sell for four hundred, five hundred, or even one thousand rupees, or about five hundred dollars, American currency.*

XVII. CYPRÆA MONETA. (Linn.)—*Money Cowry.* Hindoostanee *Kapardakas*—Guinea Coast, *Timbis.*

This little shell is indigenous both to the East Indies and the western coast of Africa. In the former they are chiefly found on the shores of the Lacadive and Maldive islands, and are thence imported into Calcutta and Bombay. In both continents they are used as a circulating medium, and in India they pass current in the British presidencies, but for very low values. In Calcutta two thousand five hundred and sixty cowries are worth one current rupee, or about fifty cents; but there are several intermediate and nominal coins, the lowest worth four of these shells. They are, however, quickly disappearing from commercial transactions where Europeans are settled. Previous to the abolition of the slave trade they were largely imported into England, to be subsequently used in Africa, and though the quantity is much diminished, they are still to be found in the price currents of London and Liverpool. In Peale's museum at Philadelphia, there is a singular head dress of scarlet cloth, entirely studded with these shells, which is said to have been brought from China.†

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* McCulloch's Commercial Dictionary, Article CHANK. Diction. Univers. de la Geographie, par J. Peuchet, Art. CEYLON.

† McCulloch's Commercial Diction. Art. COWRIES and CALCUTTA. Martyn's Hist. of the British Colonies, Vol. i. p. 357. Vol. iv. p. 589. Kelly's Univ. Cambist, 2d Ed. Vol. i. pp. 88 and 166.

XVIII. CHITON FASCIATUS? (Linn.)—*Beef Shell.*

The only instance, we believe, of any species of this genus being used, is the present, at the island of Barbadoes, where they are cooked for the table. We are told that the fish is of a pale red color, (whence its provincial name,) and that "it is very firm eating, short and well tasted." It is about one and a half inches in length, and three quarters of an inch in breadth. It appears to be abundant, and living on the rocks, is easily obtained. The shell is useless.*

XIX. MUREX DESPECTUS. (Linn.)—*Rock Whelk.*

This, the largest of the British univalves, is not uncommon on most of the coasts of Great Britain. It is occasionally drawn up with oysters, but we have most frequently obtained it from the ground lines of the fishermen, to the baits of which it adheres. In common with the rest of the genus, it is carnivorous. It is occasionally eaten, but being coarse food, is more generally used as bait.†

XX. SOLEN SILIQUA. (Linn.)—*Razor Shell.*

This shell is found in abundance on many of the sandy shores of England, especially on the northern and western coasts, and on those of Scotland and Ireland. The ancients esteemed them, when cooked, as a delicious food, and Dr. Lister informs us that he thought it nearly as rich and palatable as the lobster. In England and Scotland, in the present day, it is more used as bait than for the table, but in Ireland it is still much eaten during Lent. It is in season during the spring, and the shell is of no value. It is eaten likewise by the inhabitants of the Crimea, bordering on the Black Sea, on the shores of which it is plentifully found.‡

XXI. The OPERCULUM of a species of shell is understood to have been used in making the sacred perfume of the Jews, the substance called in the Hebrew *specheleth*, and which in the English version is translated *onycha,*[*] and by the LXX. *onyx.* Dioscorides and Rumphius both describe the shell. It is found in the marshes of India, where the Nard (*Andropogon Nardus,* Linn.) grows, on the leaves of which it feeds, and is thence said to obtain its peculiar odor. The shells are gathered in the summer, when the heat has dried up the water; and it serves as the basis of all perfumes throughout the east. According to its etymology, (ονυξ) *onyx* signifies the nail of the finger or toe, which the substance resembles, and which, according to the Greek tradition, was so called from its being the parings of Venus' nails, cut off by Cupid with one of his arrows. The best was procured from the shores of the Red Sea, which was white and large: the Babylonian was black and smaller, and therefore probably from a different species of shell.[†]

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* Hughes' Natural Hist. of Barbadoes, p. 275.

† Donovan's British Shells, plate 31.

‡ Ib. plate 46. Histoire physique, morale, civile et politique de la Russie moderne par M. Le Clerc, Vol. iv. p. 291.

XXII. MYTILUS EDULIS. (Linn.)—*Edible Muscle.*

This shell is common to most parts of the world, being met with in each of the four continents, and we believe in Australasia. Specimens from different places certainly do differ, but so slightly, and so much the same are their habits, that a scientific naturalist finds it impossible to separate the species by any decisive mark.

In the warm climates they grow to a larger size, and their flesh is more nutritive, than in the cold. They lie in large beds in shallow water, and adhere to each other or to foreign substances, by means of the byssus, which is particularly strong, but they are probably locomotive, at least when young. They succeed the best when always under water, but will also live on rocks only covered at high tide. They are generally used for the table, and make perhaps the best bait known for fishing. In England they are chiefly eaten by the poorer classes on the coasts, and seldom carried into the interior; in Lancashire, however, they have been planted in the river Weir like oysters, where they grew fat and delicious. They are plentiful on most of the coasts of France, both in the Atlantic and Mediterranean, and are commonly used not only in the maritime departments, but also in Paris; and although they are seldom admitted to the tables of the higher classes, the consumption of them is very considerable. In the neighborhood of Rochelle they are kept to fatten in salt water ponds, (*Bouchots*) into which a certain quantity of fresh water is allowed to enter; by which means they are improved both in size and flavor. They are in season in the autumn.

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[*] Exodus, ch. xxxi. v. 34. Dictionnaire de Trevoux, Vol. iv. Art. ONYX.

[†] Calmet's Dict. of the Holy Bible, Art. ONYCHA. Scripture illustrated by means of Natural Science, Vol. iv. p. 45.

In Italy, where, owing to the frequent fasts, shell fish enter more largely into the food of the people than elsewhere, this species is extremely plentiful. The sandy bed of the Mare Piccolo, on which stands the town of Taranto, is literally blackened by the muscles which cover it. The boats that glide over its surface are laden with them; they emboss the rocks which border the strand, and appear equally abundant on the shore, piled up in heaps, or packed in carts. They spawn on ropes, which are tied at intervals to poles stuck in the water, and these, when drawn out, exhibit the semblance of massive festoons of carved ebony, or brilliant black coral. When about the size of a small bean, they are plucked from the ropes, and scattered in different parts of the bay, whence, at the period of perfection, they are collected by means of iron rakes and sent to market. They are generally to be met with in the New York markets, but the consumption is not large, neither is the fish so excellent as the European: they are common on the oyster beds and other parts of the bay. The shell differs from the British species in being flatter, not so much ridged, more angular, more extended at the larger end, more polished on the outside, and it seldom grows so large or thick, but it is probably only a variety. Some parts of the fish (and at certain seasons all) are unwholesome, and there are instances where death has been caused by eating them: the shell was formerly in England occasionally used in a somewhat similar manner as that of *Mya Pictorum*, but otherwise it is of no value.

Where they abound, the European oyster is *said* to be destroyed by them, but this is not yet thoroughly proved. In Scotland, they are particularly plentiful on the western coast, and in some places are considered private property, and a revenue raised from them by making the fishermen pay a species of tax, or fixed rent for the quantity taken. They are enumerated by Holinshed among the shell fish in use in his time, and are in the present day eaten by the inhabitants of the shores of the Black Sea.*

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* Donovan's Br. Shells in loco. Hon. R. Keppel Craven's Tour through the Southern Provinces of the kingdom of Naples, pp. 183—4. Sinclair's Statist. Hist. of Scotland. Herbin's Statistique generale et particulière de la France, &c. Vol. i. pp. 384—6. Holinshed's Chronicles, Vol. i. p. 378. Le Clerc's Histoire de la Russie, Vol. iv. p. 291.

XXIII. Cardium edule. (Linn.)—*Edible Cockle.*

This common English shell inhabits the low sandy and muddy shores of most parts of Great Britain, and is found a little above low water mark. The specimens lie singly, about a foot deep in the sand, and like the *Mya arenaria* of this country, their locality is known by a dimple or depression, of about half an inch in diameter. They are dug out. They are likewise found on some of the French coasts, and in both countries are used for the table; but their consumption is entirely confined to the more humble and poorer classes. In the sixth century they were however of much more importance, and eaten by all. In general they are prepared by simply boiling them, after having been kept a few days in fresh water to get quit of the sand they contain.

In the island of Barry, on the coast of Inverness, Scotland, this fish is at times the chief support of the inhabitants, and so plentiful are they there, that in seasons of scarcity the people have subsisted solely on them for months together. The popular opinion there is, that they spring from small animalculæ, brought down by the water springs from a certain green hill in the neighborhood of the sands. Buchanan, the Scottish historian, gives a somewhat similar account of their origin, as being believed in his time throughout Scotland. Except the occasional burning of the shell as lime, or applying it as manure, it is of no value. They are in season during the spring.*

XXIV. Helix Pomatia. (Linn.)—*Edible Snail.*

Luxury perhaps attained to a greater height in ancient Rome than in any other country of which we have the history. Not only was there the most lavish splendor and magnificence in the houses and the temples; not only were these met with in the dress and equipages, but the most minute attention and refinement was applied to the science of cookery and to the table. The present shell is an instance of this: not content with eating animals as they were by nature, the greatest ingenuity was manifested in feeding and fattening them, and while Rome was mastering or holding in subjection one half the known world, thousands of birds were slaughtered to procure one dish of tongues, rivers turned from their course, and mountains cut through, to form oyster pits and lamprey stews, and patricians and senators thought it not beneath their dignity to superintend the minutiæ of snail warrens. This shell is indigenous to most parts of continental Europe, but it chiefly abounds in Italy and Spain. In the former it anciently was, and still is, much used for the table, and among the Roman epicures there was constant competition to prove who could produce the largest and the fattest. Pliny informs us that one Fulvius Harpinus was the first who invented a stew for snails about B. C. 80, in which they were fed and protected. Every care was taken of them, and the owners of these warrens boasted as much of their snails, as gentlemen, in the present day, do of their horses. Several species, from various countries, were probably used, each of which were kept in separate departments, and were regularly fed on wheat meal sodden with wine and mixed with a few laurel leaves. Thus preserved, they grew to a most surprising size, and if we can believe the authorities, it was not uncommon for the shell, (naturally about two inches in diameter,) to contain ten quarts of liquid!

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* Sinclair's Statistical Hist. of Scotland, Vol. xiii. p. 336. Holinshed's Chronicles, Vol. i. p. 378.

The *Oochlearia*, or snail stews, were generally made in open places surrounded by water, so that the snails might not abandon them, and care was taken that the places were not too much exposed to the sun or the dews. The artificial stews were most frequently made under rocks whose bottoms were watered by lakes or rivers, and if there was not a natural dew, they produced one by means of a pipe of water bored full of holes. They were also fed on a smaller scale, in large pots or pans, bored full of holes to let in the air, and lined with bran and wine lees or vegetables. In Italy they are still fed in similar places on vegetables, and during Lent are eaten in great quantities. They are regularly exposed in the markets, as well as in those of Switzerland, Spain, and France, and are exported in barrels to the Antilles. They were introduced into England about two centuries since, and distributed through the counties of Surrey and Sussex, but by whom is now uncertain. They soon spread themselves, however, through most parts of the south, and are found at present in the country round Dublin. In the north they have never prospered, and we are not aware of any place more northerly than Northamptonshire, where they are to be found. In Holstein they are indigenous as far as the shores of the Baltic, and are the most common snail of that country; but neither there nor in England are they used for the table. In France they are the objects of a small commerce; the peasants collect them in the vineyards, and feed them till winter, when they seal themselves up, and in this state they are purchased by the confectioners, who prepare them in the shell with butter and herbs, and forward them to Paris. They are recommended in pulmonary complaints, and are used by the ladies as a cosmetic. The French have a proverb drawn from this shell, which they apply to an ill formed or decrepid person—"*il est fait comme une escargot.*" They are found in the Crimea, where they are eaten by the Tartars.*

The *Helix Aspersa*, (Muller,) was introduced into England by Sir Kenelar Digby, for the relief of those affected with diseases in the lungs, but is not, that we are aware of, now ever used.

XXV. UNIO ———?—*Fresh water Muscles.*

This most abundant and interesting American family, though every where found, appears to be but little used. Some tribes of Indians eat them, and at present round one of the ponds at Plymouth, Mass., may be seen pits full of these shells, the fish of which had been consumed by the aborigines before the landing of the Pilgrims. Some of the thicker species of the Ohio, are said to have been at Pittsburgh successfully turned into buttons and ornaments resembling mother-of-pearl.

XXVI. CHAMA GIGAS, (Linn.)—*Boat Shell.*

This very fine and well known bivalve is chiefly found in the Bay of Tappanuli, in Sumatra; but is sufficiently plentiful around New Guinea, and in other parts of the east; it lies in moderately deep water, and frequently grows to a very large size. One shell described by Linnæus weighed four hundred and eighty nine English pounds, and he says the inhabitant has been known to furnish one hundred and twenty men with a day's food. Sir Joseph Banks had an account of one which weighed five hundred and seven pounds; the largest valve measured four feet six inches in length, and two feet five inches and a half in breadth, and one foot in depth. Large pearls are occasionally found, in them; the same gentleman once exhibited one which was valued at between nine hundred and twelve hundred dollars; a large shell of this sort is used as a baptismal font in the church of St. Sulpice, at Paris, and was presented by the Venetians to Francis the first. The shell is worked by the natives of Sumatra into arm rings and other ornaments, and in the hands of their artists is found to take a polish equal to finest statuary marble. It is several inches thick, and perfectly white, and might probably be used to advantage in some of the finer arts in this country. One of the methods of taking them is by thrusting a long bamboo between the valves as they lie open, when by the immediate closure that follows, they are made fast. The name for this shell in the language of Sumatra is *Kima*, whence probably our word.* It is this shell in which Neptune is represented in pictures to be riding.

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* Plin. Hist. Nat., lib. ix. cap. 32. Donovan's British Shells, Vol. III. Pl. 84. Dictionnaire de Trevoux, Art. *Escargot.* Le Clerc's Hist. Mod. de Russie. Statistique de France, Vol. I. pp. 387–388. Say's Am. Conchology, *Helix. Introd.* The information respecting the Romans, is chiefly from Varro, *De Re Rusticâ*, a copy of which the writer has not been able to meet with, and has therefore drawn his information from extracts. Those who have it in their power to consult the original, will, he believes, find more extended information on the subject.

XXVII. Cameos or *Camaieux*, are in the present day frequently made from shells. The word properly applies to the onyx stone, whether cut or not, and which is formed of layers of different colors, so that when cut the ground appears of one hue and the figure of another. The derivation of the name is *Camehuia*, an oriental word, signifying *another stone*, or *one stone placed on another*. The shells employed are from the Mediterranean, but we have not been able to ascertain the species—the genus we understand to be *Venus*. The outer coat is white, the interior layers dark red, and being very hard, admit of a fine polish. They are cut with the lapidary's mill. The substitution of shells for stones, appears to be a very modern invention. False cameos are made of pieces of glass of different colors luted together, and afterwards either cut or cast, according to the figure. It is these which are now so common and sold at so low a price.†

XXVIII. Shells have long been used by the ladies in making fancy work; sixty or seventy years since, this was particularly the fashion in Europe, and large *grottos*, on which extravagant sums had been expended were not uncommon, besides a multiplicity of fancy work in shells of all sorts. Mr. Hughes, in his History of Barbadoes, has two folio pages, vindicating the ladies against the imputation of extravagance and waste of time in their passion for this shell work, but his argument goes rather to prove that this pursuit is *more* improving than many others which the fair sex of his time followed, than that it is altogether such as ought to engross their minds to the extent it did. Though this taste is disappearing, shells are still in this country made into fancy baskets, vases, ornaments for head dresses, &c., the manufacture of which is chiefly carried on as a real art, and for profit, and as such, is of course as valuable, as far as it goes, as any other branch of ornamental industry. Articles thus made are admitted for competition at the fairs of the American Institute in New York.* Though all species are occasionally used, the principal seem to be the rice shell, (*Voluta oryza,*) the rose shell, (*Cypræa sulcata? immature,*) the green shell, (*Nerita viridis,*) some species of Tellina, &c. &c. from the West Indies. At Taranto, shell work is a regular business, but the articles are chiefly pictures, resembling mosaic work, picture frames, &c. The shells are stuck one by one, according to their shades, upon paste board, on which lines have previously been drawn. The articles are very expensive, and being of course of little use, they are purchased rather as curiosities than otherwise. There are also some manufactures of a like nature in France.†

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* Dillwyn's Des. Cat. Vol. i. p. 215. Marsden's History of Sumatra, 3d ed. pp. 15, 121.

† Chalmers' Commercial Dictionary. Dictionnaire de Trevoux, Art. Onyx.

XXIX. Some of the Indian tribes west of the Rocky Mountains make use of various colored shells, ground to an oval, or nearly round shape, as a circulating medium. The same use is made by the Indians of the eastern coast of wampum, or strings of beads cut from the *Venus mercenaria,* (Linn.) and other shells, as well for a register of events, or history of their nation. The Indians likewise use the wampum as instruments of treaty, and as *speech belts,* or letters to convene a meeting of the Sachems, when such is required for consultation.‡

The New Zealanders use shells and beads of mother-of-pearl as necklaces, bracelets, and amulets, and also stud their baskets and aprons with the same.* Being beautiful, and easily obtained, we find shells used by most savage nations as ornaments, and frequently as instruments and utensils for cutting with, drinking from, &c.

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* At the October Fair, 1836, a diploma was granted by this Society "for a beautiful shell miniature church." Journal of the Am. Institute, Vol II. p. 196.

† Hon. Keppel Craven's Tour through the Southern Provinces of Naples, p. 184. Hughes' History of Barbadoes, &c.

‡ Hunter's Manners and Customs of several Indian Tribes, p. 302. Marshall's Life of Washington, 2d ed. Vol. I. notes, p. 3—4.

XXX. The Brehmins of Hindoostan make their astronomical observations, by means of shells arranged before them on the ground, and the Egyptians and even the ancient Greeks are said to have used shells in counting and calculations.†

XXXI. At Mobile, shells are used in mending the roads, for which purpose they are said to answer well.

XXXII. By some of the aborigines of the coast of South America, a large bivalve, full of grain, was buried with the body, to feed it during its travels to the next world.

XXXIII. The stony operculum of some species of East Indian *Turbo*, are used in this country as '*eye stones*,' to remove dust, etc. from the eye.

XXXIV. Bivalves were used by the Greeks and Romans in the ostracism, the name of the person to be banished being written on the shell. Whether the Romans ever made use of shells for this purpose has been doubted; though at first they perhaps might, and afterwards only the earthenware tiles, to which the Greek name *οστρακον* was transferred.

ART. IV.—*Criticisms and suggestions respecting Nomenclature;* by ROBERT HARE, M. D., Prof. of Chem. in the Univ. of Pennsylvania. *Also, a letter from the celebrated* J. J. BERZELIUS.‡

TO THE EDITORS OF THE JOURNAL OF PHARMACY.

Philadelphia, March 4, 1837.

Dear Sirs—In September, 1833, I published in your Journal, together with some encomiums upon the treatise of Chemistry by the celebrated Berzelius, certain objections to his nomenclature, and some suggestions respecting a substitute, which I deemed to be preferable. In the following June I addressed a letter to Professor Silliman upon the same topics, in which my criticisms and suggestions were amplified and corrected in obedience to more mature reflection. A printed copy of that letter having been sent by me to Berzelius, I received in answer an epistle, of which I furnish you with a translation.

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* Cook's Voyages, 3d ed. 4to, Vol. I. p. 219, &c. where plates of these articles are given.

† Playfair on the astronomy of the Brehmins, in Transactions of Royal Society of Edinburgh, Vol. II. p. 135. Herodotus, lib. ii. cap. 36.

‡ Copied from the American Journal of Pharmacy, April, 1837.

Since the period of that correspondence, so demonstrative of candor and good feeling on the part of the great Swedish chemist, I have published two editions of my Compendium of Chemistry, in which I have pursued a course corresponding with my criticisms above alluded to. I am therefore desirous, in addition to the letter of Berzelius to lay before the public a recapitulation, a review, and an additional explanation of the grounds upon which I have ventured to employ a language, and an arrangement inconsistent with the practice and opinions of a chemist by whose authority in other respects I am usually influenced. But before proceeding with the ungracious task of endeavoring to establish the correctness of my views in opposition to those of my friend, I feel that it will be no more than justice to repeat an acknowledgment, already made in my text book, that if De Bonsdorff, myself, and others are right in considering the *double* salts of Berzelius as *simple* salts, it is to the light afforded by his investigations, that we owe the power of seeing the subject correctly. I believe the idea, that any other body besides oxygen could produce both acids and bases capable of forming salts, originated with Berzelius, in the instance of sulphur.

Recapitulation and review of the grounds of his deviating from the language and arrangement of Berzelius, and other distinguished chemists; with some additional explanations and suggestions, by R. Hare, M. D., Professor of Chemistry in the University of Pennsylvania.

According to the Berzelian nomenclature, bodies which produce salts by a union with radicals are called *halogen* or *salt producing bodies*, while those which with radicals form both acids and bases, capable by their union of constituting salts, are called *amphigen bodies* or *both producers*. Salts, produced by the first mentioned class are called haloid salts; those produced by the other are called amphide salts.

I objected to this classification, that the words *salt*, *acid* and *base*, were broad, vague and unsettled in their acceptation, having, by chemists in general, and especially by Berzelius, been employed to designate substances differing in composition, and extremely discordant in their properties; that no method of defining a salt had been devised, which had not been founded either on properties or composition; that in the nomenclature of Berzelius properties were disregarded, since among his haloid and amphide salts were found substances, differing extremely in this respect. Thus, for instance, common salt Glauber's, salt, Epsom salt, vitriolated tartar, and cream of tartar, were associated with the fuming liquor of Libavius, the butyraceous chlorides of zinc, antimony, and bismuth, plumbum corneum, luna cornea, fluor spar, and the acid fluorides of silicon and boron. I objected also that composition could not be resorted to consistently with his classification; since, agreeably to it, a salt might be either a binary compound of a halogen body with a radical, or consist of two binary compounds, each containing the same amphigen body.

To the terms *acid* and *base*, as employed in his nomenclature, I objected, that neither by the celebrated author, nor by any other chemist had any definition been adhered to which could, consistently with his plan, restrict the meaning of those appellations to the binary compounds formed by the union of his amphigen bodies with radicals.

Acidity and basidity* had sometimes been distinguished by an appeal to properties, sometimes to composition, but to neither had there been any consistent attention. In order to demonstrate the total neglect of properties latterly displayed, it was only necessary to contrast substances bearing generally the name of acids; as for instance sulphuric acid with rock crystal, acetic acid with tannin, and prussic acid with margaric; or to contemplate simultaneously the admission of the hydracids formed with the halogen bodies into the class of acids, while alleged incapable of combining with bases, with the exclusion from that class of nitrous acid, upon the plea of the same incapacity.

In reference to neglect of composition in forming the class of acids, it will be sufficient to advert to the association in that class, of compounds formed with radicals both by the halogen and amphigen bodies; so that the halogen bodies are in one case producers of salts, in the other producers of acids; in one case act as supporters, acidifiers, or electro-negative principles, in another as radicals to the comparatively electro-positive hydrogen, pre-eminently a radical by the definition of that word given in the treatise of the distinguished author of the nomenclature.

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* For the use of the words basidity and salidity, I have no authority; but conceive that through their analogy with acidity, their meaning is so obvious as to make it expedient to employ them.

After stating my objections to the basis of the Berzelian nomenclature, I proceeded to mention those to which I considered the superstructure as liable.

Having designated the acid compounds of his amphigen class, by prefixing syllables indicating their electro-negative ingredients; having also in some instances, as in those of the fluosilicic, and fluoboric acids, adopted this course in relation to halogen bodies; I objected to the use of the word hydracid, in which the electro-positive radical is made to act as if coordinate with oxygen.

Moreover, the termination in *ide* having been generally attached to the electro-positive compounds of oxygen, acting as bases, I condemned the employment of that termination, to distinguish the electro-negative and acid compounds of sulphur, selenium, and tellurium. I considered it inconsistent to give precedence to the syllable designating the radical in the acids formed with hydrogen; as in hydrochloric, hydrobromic, hydriodic, hydrofluoric, hydrofluoboric, hydrofluosilicic, preferring the terms chlorohydric, bromohydric, iodohydric, fluohydroboric, fluohydrosilicic, &c., in which I have been sanctioned by Thenard and others.

I proposed a definition of an acid and a base, which I conceived to be the only one which could be adopted, consistently with the use made of those words by Berzelius, and other distinguished chemists; and advanced that, agreeable to that definition, his double haloid salts must be considered as *simple* salts, severally formed of an acid and a base.

I objected to his treating the words combustion and oxygenation as synonymous.

Having thus made the reader acquainted with the substance of my criticisms upon the Berzelian nomenclature, I will subjoin his letter in answer to them, and will then state, and endeavor to justify, the conclusions at which I have arrived.

Letter from Prof. J. J. Berzelius of Stockholm to R. Hare, M. D., Professor of Chemistry in the University of Pennsylvania, acknowledging the receipt of a communication respecting Nomenclature, and replying thereto.

Stockholm, September 23, 1834.

Sir—I am very much obliged to you for the remarks, which, under the date of June 21st, you had the friendship to communicate to me respecting the nomenclature which I have employed in my Treatise of Chemistry.

I perceive that having contemplated chemical phenomena under different points of view, we differ as to the nomenclature which is the most appropriate for their description. I consider the combinations of metals with chlorine, bromine, &c., as salts; whilst you, in accordance with Mr. De Bondsdorff, consider them as bases and acids, capable of forming salts by their union.

If it were expedient that chemical classification should be dependent on the number of simple bodies which enter into each combination, this idea of Mr. De Bondsdorff would without doubt be preferable; but if attention be due to the chemical properties which characterize combinations, we cannot adhere to an arrangement founded on the number of the elements. Yet so essential is it in chemistry to have reference to properties, that a system of chemistry in which common and analogous properties should not affect the arrangement, would present a mass of facts so chaotic, that no memory would be competent to retain them. In a system thus strictly conformable to the ideas of Mr. De Bondsdorff, cyanogen, though in its properties resembling chlorine or bromine, which are simple bodies, ought to be considered, also, as a base or as an acid, having azote for its radical—I am persuaded you would not approve of extending the system of De Bondsdorff so far; but if it be correct, it would be inconsistent not to make this extension.

But let us return to the combinations of the metals with chlorine, fluorine, &c., and make, in imagination, the following experiment. Let us take two portions of caustic potash, a base in which the *basic* characters are more striking than in any other. To one, let us add a sufficiency of sulphuric acid to extinguish entirely its *basic* property; we shall then have a neutral body of a saline taste. You will admit it to be a salt. Now let us add to the other portion, hydrofluoric acid. At a certain point the *basic* properties of the potash will disappear, and we shall have a resulting compound quite as neutral as the sulphate of potash, endowed with a saline taste entirely analogous to that of the sulphate. The basic properties of the potash are destroyed by the hydrofluoric acid, as well as by the sulphuric acid. But you will allege the resulting combination is not a salt, but a base which has exchanged one basifier (oxygen) for another basifier (fluorine.) In proof you may add as much more hydrofluoric acid, which combining with the new base will form with it a crystallized salt. But this salt is not neutral, it has almost the same acidity of taste as the hydrofluoric acid employed. The new base does not destroy then the acid reaction.

Let us make a further addition of sulphuric acid to the sulphate of potash. A salt equally acid will result, in which the sulphate of of potash acts the same basic part towards the sulphuric acid, as the fluoride of potassium towards the hydrofluoric acid. Should it be desired to extend the comparison further, it will be found that for each less electro-positive fluoride, susceptible of combination with the potassic fluoride, there will be, with but very few exceptions, a corresponding sulphate, susceptible of combination with the sulphate of potash. The analogy is then complete, it exists not only in the perfect neutrality of the two potassic salts, in their saline taste, but also in their manner of forming combinations with other bodies; notwithstanding one of them, the sulphate, contains one element more than the other. If, instead of potash, potassium were employed to saturate our two acids, the analogy of the operation in both cases, would be still more complete. The same quantity of metal would displace equal volumes of hydrogen. When the visible results of our experiments are so perfectly analogous, it is to be presumed that the invisible process which we do not see, may also be perfectly analogous, and that if facts exactly alike are explained differently, there must be a defect in the explanation. If, for instance, the true electro-chemical composition of the sulphate of potash should not be $KO+SO^3$, as is generally supposed, but $K+SO^4$,* and it appears very natural that atoms, so eminently electro-negative as sulphur and oxygen, should be associated, we have, in the salt in question, potassium combined with a compound body, which, like cyanogen in $K+C^2N$,† imitates simple halogen bodies, and gives a salt with potassium and other metals. The hydrated oxacids, agreeably to this view, would be then hydracids of a compound halogen body, from which metals may displace hydrogen, as in the hydracids of simple halogen bodies. Thus we know that SO^3, that is to say, anhydrous sulphuric acid, is a body whose properties, as respects acidity, differ from those which we should expect in the active principle of hydrous sulphuric acid.

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* In the Berzelian symbols, K stands for kalium, or potassium, S for sulphur, O for oxygen, and O^3 for three atoms of oxygen, O^4 for four atoms of oxygen.

† That is to say, if the salt called sulphate of potash, be considered as compound of potassium, and a quadroxide of sulphur, instead of being viewed as a protoxide of potassium, or potash, and tritoxide of sulphur, or sulphuric acid. This is the formula for cyanide of potassium, consisting of potassium, K, and cyanogen, or two atoms carbon and one of nitrogen, C^2N.

The difference between the oxysalts, and the halosalts is very easily illustrated by formulæ. In K|FF—fluoride of potassium, there is but one single line of substitution, that is to say, that of K|FF, whilst in KOOOOS (sulphate of potash) there are two, K|OOOOS and KO|OOOS of which we use the first in replacing one metal by another, for instance, copper by iron; and the second in replacing one oxide by another.

I do not know what value you may attach to this development of the constitution of the oxysalts (which applies equally to the sulphosalts and others:) but as to myself, I have a thorough conviction, that there is therein, something more than a vague speculation; since it unfolds to us an internal analogy in phenomena, which, agreeably to the perception of our senses, are externally analogous. If these phenomena are to be considered agreeably to the ideas of Mr. De Bondsdorff, how does it happen that sulphur, phosphorus, arsenic, and other radicals of the strongest oxacids, when united with chlorine, bromine, iodine, &c., do not combine with chlorides,* bromides, &c., of the metals of the alkalies and of the earths; whilst the chloride and bromide of potassium combine easily with those of magnesium, iron, and manganese. Should then the chloride of magnesium, or that of manganese, be a stronger acid than the chloride of sulphur, or chloride of phosphorus? How is it consistent with these ideas that we can obtain crystallized salts as well with, as without water, of combination, composed of chloride of calcium and of oxalate, or of acetate of lime? Should the oxysalt be here the acid, or the base? I have now displayed to you, the considerations which have guided me, and which I think are not destitute of foundation.

I cheerfully admit that it would be preferable to employ the word chlorohydric, instead of hydrochloric. My motive for retaining this last, is, that I have ventured to propose a new nomenclature in a language foreign to me, in which it was inexpedient to make changes which could be avoided without inconvenience. I also agree with you, that we ought not to use combustible and oxidable, as having the same meaning. I have deserved your strictures for this inconsistency in my language; but I must suggest as an apology, that the two words were formerly used as synonymous, and that the work, in which you have recently noticed this oversight, was first published in 1806, having been from time to time remoulded for new editions, without its having been possible to eradicate all that has not kept pace with the progress of science.

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* I have translated chlorure, fluorure, bromure, by chloride, fluoride, and bromide, agreeably to the practice of the British chemists.

Accept the assurance of my perfect esteem, and of the sentiments of sincere friendship with which I have the honor to be, Yours, &c.

An Examination, by the Author of this Article, of the Suggestions in the preceding Letter of BERZELIUS, *and how far the Objections made to his Nomenclature are therein answered.*

So far as my strictures were founded on the alleged difficulty of defining the terms acid, salt and base, in any mode consistent with his classification, they are not met by any facts or reasoning in the much esteemed letter of my illustrious correspondent. The impracticability of defining a salt, he does not deny; and with great candor he admits that, in his definiton of acidity, he has not been consistent. He concedes that it would be preferable to give the syllable, indicating the electro-negative ingredient, the precedence, as nothing but unwillingness to innovate, prevented him from pursuing that course.

He acknowledges that as combustion, in many instances, takes place without the presence of oxygen, the application of the word combustible, should not be confined to bodies which are susceptible of oxydizement.

My definition of acidity was as follows:—

"*When, of two substances capable of combining with each other so as to form a tertium quid,* and having an ingredient common to them both, one prefers the positive the other the negative pole of the Voltaic series, we must deem the former an acid, and the latter a base. Also all substances having a sour taste, or which redden litmus, must be deemed acids, agreeably to usage.*" This definition I would now amend by leaving out the last sentence, and substituting therefor, the following: *Also when any substance is capable of forming a tertium quid with any acid or base agreeably to the preceding definition, it must be considered as an acid in the one case, a base in the other.* The definition, thus amended, takes in the organic acids and bases. In the form in which it was at first proposed, it has not been alleged defective by Berzelius; but he has striven to show an incongruity in the attributes of his double salts, when contrasted with those resulting from the union of some of the acids and bases of his amphigen class; which incongruity is, in his opinion, a sufficient reason for not considering them as *simple* salts, and their ingredients as acids and bases, agreeably to the opinions of De Bondsdorff and myself.

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* This term *tertium quid* has been used by chemists, more formerly than of late, to designate a compound resulting from the union of two bodies, but in its properties resembling neither.

Berzelius errs in confounding my opinions with those of De Bonsdorff. However I may have admired the sagacity with which that chemist investigated the pretensions of some haloid salts to certain attributes of acidity or alkalinity; in my letter on the Berzelian nomenclature, I signified my unwillingness to rest my opinions upon a basis so narrow, as that which he had endeavored to establish. I stated that I did not deem it necessary to appeal to his excellent observations, proving certain attributes of acidity to exist in one case, those of alkalinity in the other. I alleged my definition to be founded on the conviction that the property of affecting vegetable colors, on which that sagacious chemist lays so much stress, has not latterly, been deemed necessary in acids; and that in bases never was required. As respects them, it only served as a mean of subdivision between alkaline oxides and other oxibases.

I am at a loss to discover in what part of my letter there was any language which could convey the erroneous impression, that, in defining acids and bases I proposed to overlook properties, and to be regulated by attention to the number of atoms in a compound. Certainly nothing was more foreign to my thoughts.

It is assumed by Berzelius that the saturation of the fluobase of potassium by fluohydric acid, cannot be considered as analogous to the saturation of the oxybase of potassium by sulphuric acid; because the resulting compound is to the taste, in one case neutral, in the other sour. In reply I suggested that if the salidity of the biborates and bicarbonates was not to be questioned on account of their alkaline taste, nor that of the protochloride of tin on account of its sourness, it was not consistent that the pretensions to salidity of the fluohydrate of the fluobase of potassium should be denied on account of its sour taste. I will now add that if the fluosilicate of potassium be a double salt, the fluoride of silicon one of its two constituents must be a simple salt, and yet it is sour. If a simple salt may be sour, why may not a double salt have this attribute; and how in fact can its presence be inconsistent with salidity? Is not the absence of this characteristic in silica and tannin, and many other acids, as much against their claims to acidity, as its presence in other compounds is an objection to their association with saline bodies. It is considered by Berzelius an objection to the views which I have espoused, that the halogen bodies, while forming acids with various metallic radicals which oxygen does not acidify, do not form acids with sulphur, phosphorus, and arsenic which oxygen does acidify; yet what is there in this, more difficult to reconcile with the established results of chemical combinations, than in the fact that oxygen forms with sulphur, phosphorus, and arsenic, strong acids, with hydrogen water; while with hydrogen the halogen bodies all form compounds which Berzelius describes as having the highest pretensions to acidity. The highly active acid properties of the fluorides of boron and silicon, would lead us to expect similar compounds to be formed by the same radicals, with the other halogen bodies, contrary to experience. Chemistry makes us acquainted with many similar discordances. How is it that oxygen forms aëriform compounds with an extremely fixed body in the instance of carbon; while in that of phosphorus or arsenic, both volatilizable, it forms acids which are comparatively insusceptible of volatilization? Wherefore does not hydrogen produce an acid with phosphorus and arsenic, as well as with sulphur?

According to Berzelius, all the halogen bodies produce with hydrogen combinations which are as highly endowed with the attributes of acidity, as the strongest acids into which oxygen enters as a constituent. It is conceded in his letter that his language respecting these combinations cannot be reconciled with his declaration in one place that they do not combine with oxybases, and in another that a body which cannot so combine is not an acid. It strikes me, that the only way in which the admitted inconsistency of his description of these bodies, with his definition of acidity, can be avoided, is by assuming that they combine as acids with haloid bases, although decomposed by oxybases.

I will now proceed to comment on a new subject for consideration, presented in Berzelius's letter in reply to mine.

It must be evident that every oxysalt, composed of an oxacid and an oxybase, must consist of an atom of each radical, and as many atoms of oxygen as exist both in the acid and in the base. Thus sulphate of potash consists of an atom of potassium, an atom of sulphur and four atoms of oxygen, and may be represented either by SOOO KO or SOOOOK.

Berzelius in his letter repeats an ingenious suggestion previously advanced in his treatise, that SOOOO, (sulphur with four atoms of oxygen,) may act, as a compound halogen body like cyanogen, and thus form a salt by union with an atom of any radical. He conceives that the apparent want of analogy, which induced him to separate into two classes, the amphigen and halogen bodies, disappears under this view of the phenomena ; and that his amphide salts might be considered as constituted of a compound halogen body and an elementary radical. But however we may admire the ingenuity of these suggestions, ere, in obedience to them, we extend the limits of the halogen class, I would request that the word salt should be defined, and that it be shown that consistently with any definition which can be devised, there is any class of bodies in nature which merit the appellation of salt producers. Before enlarging the superstructure, let it be shown that the basement has been well grounded.

Berzelius lays some stress on the community of effect, in the evolution of hydrogen, both by acids formed by hydrogen with halogen bodies, and by diluted hydrous sulphuric acid, as evincing a similitude of composition justifying the suggestion above quoted from him. But I conceive that this common result is better explained by ascribing it to the tendency of radicals to displace each other from combination, whether existing in a simple or a complicated compound. If water exists as a base in hydrous sulphuric acid ; as I have elsewhere suggested, we may consider this hydrous acid as a sulphate of the oxybase of hydrogen ; and that when it reacts with zinc or iron, the proneness of hydrogen to the aëriform state enables either metal to take its place, agreeably to the established laws of affinity.

It may be proper, before concluding, to explain more particularly the nomenclature which I have adopted.

The amphigen, and halogen bodies of Berzelius as they produce acids and bases according to my definition, are all classed as basacigen bodies. Of course oxygen, chlorine, bromine, iodine, fluorine, cyanogen, sulphur, selenium and tellurium, are included in this class. The general designation of a binary compound of a basacigen body, is the termination in *ide ;* the special, the termination in *acid*, when the compound acts as an acid, in *base*, when it acts as a base.

Hence an oxide, may be an oxacid, or an oxybase ;

a chloride,	a chloracid,	or a chloribase ;
a bromide,	a bromacid,	or a bromibase ;
an iodide,	an iodacid,	or an iodobase ;
a cyanide,	a cyanacid,	or a cyanobase ;
a sulphide,	a sulphacid,	or a sulphobase ;
a selenide,	a selenacid,	or a selenibase ;
a telluride,	a telluracid,	or a telluribase ;

Compounds which consist of radicals only, are distinguished by the term *uret* equivalent to the French *ure*. Hence *carburet, phosphuret, boruret, silicuret, &c.*

Of any two binary compounds containing each the same basacigen body and forming one compound, the more electro-negative is an acid, the other a base. Hence all the electro-negative haloid compounds in the Berzelian double salts, are acids, and the electro-positive, bases. Where there are two such compounds one containing one basacigen atom, the other two atoms or one and half, the former has a termination in *ous*, the latter in *ic*. As for instance the *chlorureplatinosopotassique* of Berzelius, is a compound of *chloroplatinous acid*, and the *chlorobase of potassium*, and is the *chloroplatinite of potassium*. The *chlorureplatinico-potassique* of the same author, is the *chloroplatinate of potassium.**

By analogy the intelligent reader may easily make these examples a clue to designate any other of the double salts of Berzelius so as to accord with the plan in question. He may have a *bromoplatinate*, or *bromoplatinite*, a *iodoplatinate* or *iodoplatinite*, a *fluoplatinate, &c.;* or exchanging the radical a *chloroaurate* or *chloroaurite*, a *bromoaurate* or *bromoaurite, &c.*

The terms amphigen and halogen being employed both from expediency, and in honor of their author, we may use his terms haloid and amphide, to distinguish the acids or bases severally formed by these classes, the abbreviations *halo* and *amph*, being employed in composition. Thus I designate the acids formed by the halogen bodies with hydrogen, as halohydric acids; those formed with that radical by the amphigen bodies, as amphydric acids. As the same radical will in other cases be found to form acids with several of the halogen bodies, platinum for instance, the acids thus produced, may be called haloplatinic aids; or if gold were the radical, they would be called haloauric acids. These examples will suggest to the chemical reader a series of names, as for instance *haloargentic*, *halocupric*, *halostannic*, *halopalladic*.

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* In designating salts of the metals proper, as for instance, the *nitrate of mercury;* the idea of the oxydisement of the metal is always understood, although usually not expressed. In the instance above cited, we actually mean the *nitrate* of the *oxide* or *oxybase* of mercury. By analogy, I here use the term *chloroplatinate of potassium*, for *chloroplatinate* of the *chlorobase* of *potassium*. It is in fact, well known to chemists, that acids do not unite directly with metals. The only alleged exception to this rule, of which I have any knowledge, is that of tellurium and sulphuric acid. It is inferred, therefore, that when an acid is combined with a metal, the latter must exist in the state of a base formed with the basacigen body which enters into the composition of the acid.

I consider prussian blue as a cyanoferrite of the cyanobase of iron, or briefly a cyanoferrite of iron. The diversity of properties which enables two cyanides of iron to exist in combination in this cyanoferrite, one as an acid, the other as a base, is one among many other instances in which compounds constituted of the same elements in the same ratio, have different properties, and are said in consequence to be *isomeric*, or to afford cases of *isomerism*.

The salt designated by Berzelius as the "*cyanure ferroso-potassique*," is the well known test for iron heretofore called ferroprussiate of potassa; under the idea that it consisted of prussic acid, iron, and potassa. As the prussic acid was viewed at the same time as a compound of hydrogen and cyanogen, the ferroprussic acid was considered as a compound of cyanogen, hydrogen, and iron. According to Berzelius, the supposed *ferroprussiate* is a compound of a "*protocyanure*" of iron, and a "*cyanure* of *potassium;*" each being a simple haloid salt, and the aggregate a double "*cyanure*." Agreeably to my nomenclature, the "*protocyanure*" of iron is considered as cyanoferrous acid, and the "*cyanure*" of potassium as a cyanobase; the aggregate being a cyanoferrite of the cyanobase of potassium, but designated briefly as a cyanoferrite of potassium.

I infer that the "*ferroprussic*" acid is analogous in constitution to the triple compound of fluorine, silicon and hydrogen, improperly called hydrofluosilicic acid; and that, consistently with the hypothetical views under which the latter received its name, the former should be called hydrocyanoferric acid. Even admitting the correctness of the hypothetical impression, to which I have alluded, agreeably to which such compounds are acids with a double radical, I urged that the appellations of such compounds should be so altered as to give precedency to the electro-negative ingredient. Hence the one would be called cyanohydroferric acid; and the other, fluohydrosilicic acid. But in my letter to Prof. Silliman, already cited, I advanced a new hypothesis respecting the constitution of the fluohydrosilicic, and fluohydroboric acids. I suggested that they should be considered as compounds in which the fluorides of silicon or boron acted as acids, the fluoride of hydrogen as a base. Consistently with that doctrine, I would consider the *protocyanide* (or "*cyanure*") of iron in the alleged *ferroprussic acid*, as acting as *cyanoferrous acid*, the *cyanide* of *hydrogen* (*prussic acid*) as a *cyanobase* forming, by their union, a cyanoferrite of hydrogen.

As compounds, consisting of a basacigen body, hydrogen and a radical, do not, when presented to bases, enter into combination; but are on the contrary, decomposed so as to allow another radical to take place of their hydrogen, it is inconsistent with chemical law, as stated by Berzelius,* or my definition of acidity, (page 9,) to designate them as acids.

I have called the electro-negative "*protocyanure*" of iron of Berzelius, cyanoferr*ous* acid, because there is "sesquicyanure" in the "*cyanureferrico-potassique*" of that author, which by analogy with the nomenclature of the oxacids, is entitled to the appellation of cyanoferric acid.

Art. V.—*Description of an Electrical Machine, with a Plate four feet in diameter, so constructed as to be above the Operator: also of a Battery Discharger employed therewith: and some Observations on the Causes of the Diversity in the Length of the Sparks erroneously distinguished by the terms Positive and Negative;* by R. Hare, M. D., &c. &c. &c.

The opposite engraving represents a machine with a plate four feet in diameter, which I have recently constructed so as to be permanently affixed to the canopy over the table of my lecture room.

This situation I have found convenient even beyond my expectations, as the machine is always at hand, yet never in the way. In lecturing, with the aid of a machine on the same level with the lecturer, one of two inconveniences is inevitable. Either the machine will occasionally be between him and a portion of the audience, or he must be between a portion of the audience and the machine. Situated like that which I am about to describe, a machine can neither hide the lecturer, nor be hidden by him. With all its power at his command, while kept in motion by an assistant, he has no part of it to reach or to handle besides the knob and sliding rod of the conductor, which are in the most convenient situation.

The object of this machine being to obtain a copious supply of electricity for experiments, in which such a supply is requisite, it was not deemed necessary to insulate the cushions and the axis, as in the electrical plate machine which I employ for experiments requiring insulation.†

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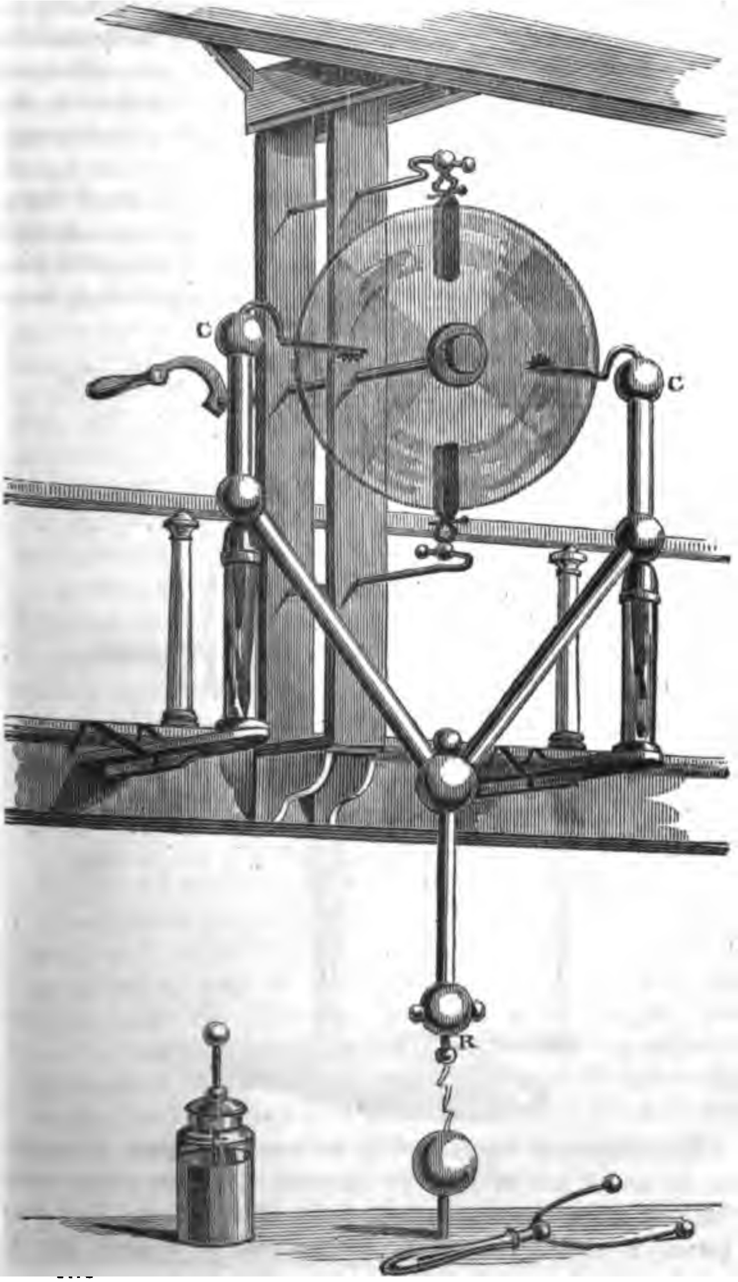
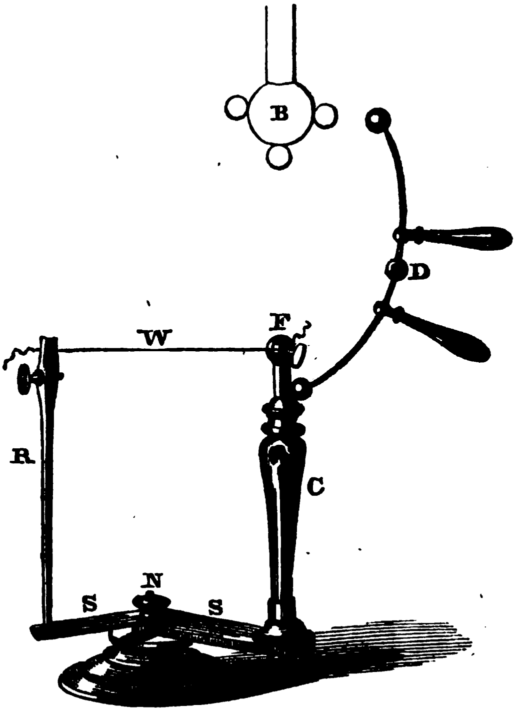
* Traite, page 41, vol. ii.

† See this Journal for 1823, vol. vii, p. 108; or London Phil. Mag. for 1823, vol. xxiii, p. 8.


C
C
R

The prime conductor is supported and insulated by means of wooden posts covered by stout bell glasses, so that the summits of the latter are between those of the posts and the inner surfaces of caps attached to the conductor. By these means the glass is subjected to pressure, but is liable to no strain. Such a support combines the advantages both of wood and glass. At C C, are the collectors. R represents a sliding rod, which may be drawn out to such an extent as to be brought in contact with any apparatus placed under it upon the table. In fact, the large rod in which the rod R slides may be slipped up to any elevation through the hole in the brass ball which sustains it.

Dr. Hare's Battery Discharger for deflagrating wires.



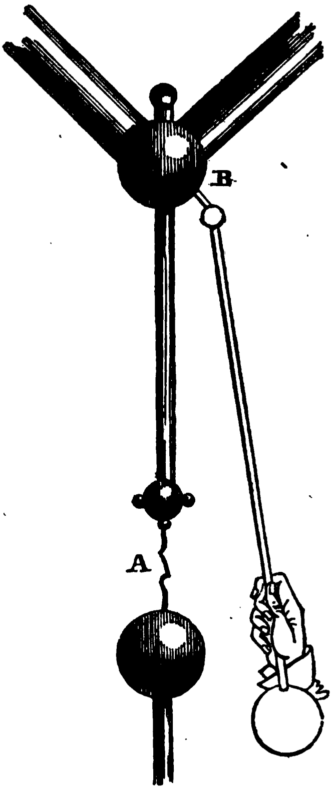
The instrument represented by the preceding figure, is employed by me in lieu of Henley's universal discharger; being better adapted to my apparatus, and mode of operating. Two brass plates, S S, are secured to the pedestal by a screw bolt N, which passes though a hole made in each, near one extremity: the plates are thus allowed a circular motion about the bolt, so as to be set in one straight line, or in any angle with each other. On one of the plates near the extremity not secured by the bolt, a brass socket is soldered, into which a glass column C is cemented, surmounted by a forceps. At the corresponding end of the other plate, there is a brass rod R, perpendicular to the plate, and parallel to the glass column. This rod is also furnished with forceps. Between these forceps, and those at F, supported and insulated by the glass column C, a wire is stretched, which may be of various lengths, according to the angle which the plates S S make with each other. The pedestal should be metallic, or have a metallic plate at bottom, in communication with the external coating of the battery. This being accomplished, it is only necessary to charge the battery, without subsequently breaking the communication between the inner coatings of the jars, and the prime conductor, by which the charge is conveyed. In that case, touching the conductor, is equivalent to a contact with the inner coatings of the jars, so far as electrical results are concerned. Hence, by causing one of the knobs of the discharger D, with glass handles, to be in contact with the insulated forceps F, and then approximating the other knob to the prime conductor B, the charge of the battery will pass through the wire W, as it cannot descend by the glass column, nor reach the operator through the glass handles. These should be longer than represented in the cut.

Long zigzag or erratic spark, contrasted with the short straight spark.

"The cause of this difference between the lengths of the two electricities, we have no means of explaining."—*Thomson's work on Heat and Electricity.*

The object of the engraving on the following page is to represent the different forms and lengths of the electric spark, which take place between a large and a small ball, accordingly as they are made negative or positive. The long and zigzag, or erratic spark A takes place between a small ball attached to the positive pole, and a large one associated with the negative pole. The short straight spark B is elicited under circumstances the reverse of those just mentioned. They are represented as simultaneous, but with the same machine, can of course, only be obtained in succession.

In no respect do the phenomena of mechanical electricity appear more favorable to the Franklinian theory, and more inexplicable, according to the doctrine of two fluids, than in the diversity of the electrical spark in passing between a small and a large metallic ball,



according to the manner in which the balls are associated with the positive or negative poles of the machine. When the small ball is attached to the positive pole, the spark is long, comparatively narrow, and of a zigzag shape, such as lightning is often seen to assume; but when the situation of the balls is reversed, the spark is straight and thick, not one third as long, and nothing of a zigzag shape can be observed in it.

According to the Franklinian theory, when any body is more highly charged with electricity than the adjoining bodies, the excess of the fluid is attracted by them, while it is inadequately repelled by the inferior quantity of the electric fluid, with which they are imbued. It follows that when a small globe is made positive in the neighborhood of a large one, the excess of electric matter in the former, is attracted by all the negatively excited metal in the latter. When the small globe is made negative the metal of which it consists attracts all the electric matter in the large globe. Hence there is this difference in the two cases; the small globe being positive, a comparatively small *movable mass* of electric matter, is attracted by a large immovable mass of metal: the small globe being made negative, a large *movable mass* of electric matter is attracted by a small immovable mass of metal. The charge being in both cases the effect of the same machine; the attractive power must be as great in one case as in the other. The forces by which the masses are actuated being therefore equal, it is quite reasonable that the greatest projectile power should be attained, when the small mass is movable. In that case, it will require less air to be removed in order to effect a passage.

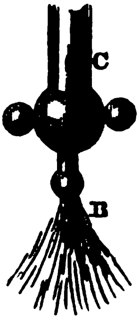
There is an analogy between the difference which I suppose to exist in the case under consideration, and that which may be observed between the penetrating power of a rod which is blunt, and one which is pointed.

It remains to show why a large mass of electric matter will be discharged in a spark when there is sufficient proximity, although that electric matter be situated in the large globe, and attracted by the other, under circumstances in which, as above stated, it would not pass without that proximity.

It must be evident that attraction increases, as the distance between the bodies which exercise it lessens. Of course the attraction of the small globe must always act more powerfully on those portions of the electric fluid, which occupy the nearest parts of the positively excited globe. But this difference of distance, and consequent diversity of attraction, increases as the globes are approximated. Thus that portion of the electric fluid which sustains this pre-eminent attraction, will be accumulated into a conoid; the acuteness of which, and attraction causing the acuteness, increasing with the proximity, there will at last be sufficient projectile and penetrative power to break through the air, and thus open a passage for the whole of the quantity attracted by the small negatively excited globe.

When, by the process last described, the fluid is made to leap through a comparatively small interval, by the concentrated attraction exercised by a small negative ball upon the extensive surface of the electric matter diffused through a large globe, the air does not become sufficiently condensed to resist it before it reaches its destination, and, of course, it cannot assume the erratic form which would arise from repeated changes in its course, as in the instance of the long spark.

Of the Electrical Brush.



When the machine is in active operation, and the prime conductor insulated; from a small knob attached to it, as at B, in the figure, the electricity will be sent off, as by the concomitant light to exhibit the form of a luminous brush, as represented in this figure at B. For the production of this phenomenon, it is necessary that the electric fluid shall be condensed into a small prominent mass, so as, agreeably to the preceding explanation, to have great penetrating power. This it cannot possess, when, with the same intensity in the generating power, a large ball is positively electrified. In that case, the electric column presents a front too broad to procure a passage through the surrounding non-conducting air. A small ball, negatively electrified, can only be productive of a diffuse attraction for the electricity in the atmospheric medium around it; so that it has less ability to create any penetrating power, than when acting upon the electricity in a comparatively large globular conductor, as in the preceding illustration. Hence, when the knob is on the negative pole, it may be productive of a luminous appearance in its immediate vicinity, where the electric matter, converging from the adjoining space, becomes sufficiently intense to be productive of light; but it does not produce the striking appearance of the luminous brush.

As, agreeably to Du Fay's theory, the knob, whether vitreously or resinously electrified, is surcharged with an electric fluid, the projectile power ought to be as great in the one case as in the other; and the long spark and the brush should be producible in either case.

On some Inferences from the Phenomena of the Electric Spark, in a recent work on Heat and Electricity.

In his valuable work on heat and electricity, Dr. Thomson states that if a long spark be taken between two knobs, as when severally attached to the positive and negative conductors of the electrical machine; the portion of the spark near the positive knob exhibits all the characters of positive electricity, while the remaining portion proceeding from the other knob displays all the characters of negative electricity. Although the learned author does not state what differences there are between the different portions of the spark, and wherefore, if any exist, he can, without a petitio principii, assume that they are such as to justify his conclusion; he proceeds to allege that there can be no doubt that every spark consists of two electricities; and that these, issuing severally from their respective knobs, terminate their career by uniting at the non-luminous portion of the spark, which is at a distance from the negative knob of about one third of the interval. Upon these grounds he infers that the positive electricity occupies two thirds of the length of the spark, the negative one third.

I presume that, agreeably to the theory which supposes the existence of two fluids, when the equilibrium between oppositely excited surfaces is restored by a discharge, whether in the form of a spark or otherwise, there must be two jets or currents passing each other; the one conveying as much of the resinous as the other does of the vitreous electricity. Of course no part of a spark can be more negative than it is positive, nor more positive than it is negative. Hence I do not approve of another suggestion of the same author, that the diminution of light near the middle of the spark results from the combination of the different fluids at this point. It appears to me that there is as little ground for supposing the union of the fluids to take place there as elsewhere. But admitting that the union does take place as supposed, is this a reason for the observed diminution of light? If, when isolated, either fluid is capable of emitting a brilliant light, should not their co-operation increase the effect? If, after their union, they do not shine, it can only be in consequence of their abandoning, at that moment, all the light with which they were previously associated. It cannot be imagined that the light accompanying one should neutralize that accompanying the other.

In deflagrating, by voltaic electricity, a wire of uniform thickness, equally refrigerated, the most intense evolution of heat and light is always midway.

In truth, the theory which the learned author sanctions, requires two postulates so irreconcilable, that unless one be kept out of view, the other cannot be sustained. It requires that the fluids should exercise an intense reciprocal attraction, adequate to produce chemical affinity, and of course, enter into combination when they meet, and yet rush by each other with inconceivable velocity, not only through the air, but also through the restricted channel afforded by a small wire. If the fluids combine at a point intervening between the surfaces from which they proceed, what becomes of the compound which they form? Is it credible that such a compound would afford no indication of its existence? But, again, how are two surfaces, the one previously deprived of a large portion of the negative electricity naturally due to it, the other made as deficient of the positive fluid, to regain their natural state? By a combination midway, the resinous and vitreous surcharges might be disposed of, but whence could the vitreous and resinous deficiencies be supplied?

Dr. Thomson, in common with the great majority of modern chemists, ascribes chemical affinity to the attraction between the two electricities combined with ponderable particles. As the combinations between such particles take place only in definite proportions, would it not be consistent that the fluids which give rise to them, should combine agreeably to those laws? But if the electrical compound, formed of the vitreous and resinous electricities, be decomposable by induction, as the theory in question requires, its constituents must be capable of uniting in every proportion.

Agreeably to the late investigations of the celebrated Faraday, equal quantities of the electric fluid are evolved by analogous chemical changes, in equivalent weights of different ponderable bodies. It may therefore be inferred, that in entering into combination the electric fluid is obedient to those laws of definite proportion which regulate other substances.

It may be imagined, perhaps, agreeably to the undulatory theory, that the undulations produced at the non-luminous point are such as to destroy each other. But this I conceive would be a surmise requiring proof, rather than a fact on which to found an opinion.

ART. VI.—*Of an Improved Barometer Gage Eudiometer*; by Prof. R. HARE, M. D., &c. &c.

ABOUT nine years ago* I published an account of a hydro-oxygen eudiometer, in which the measurement of the gases was effected by means of a barometer gage. In the apparatus then employed, the receiver was of glass, and was, of course, fragile. Subsequently I employed a stout iron bottle in lieu of the glass.

The essential constituents of this apparatus are an air tight vessel, sufficiently strong, and having screw apertures for the insertion of valve cocks, V V V, a thermometer T, and a galvano-ignition apparatus† W W; also a barometer gage G, communicating by a leaden tube with the vessel through one of the valve cocks.

An air pump, pneumatic cistern or trough, and reservoirs for gas, are necessary auxiliaries.

It is an important characteristic of the barometer gage eudiometer, that it is applicable on a much larger scale than any other. It is only necessary to make the requisite apertures, and tap them for appropriate screws, in order to transfer the valve cocks, thermometer and ignition apparatus, with all the essential means of operating, to any air tight cylinder of any size; to a large cannon for instance, the mouth being closed. The sources of inaccuracy, if any exist, must lessen in proportion to the result, as the quantity acted upon is augmented. It would, of course, be safer to extend the cylinder in length than in diameter.

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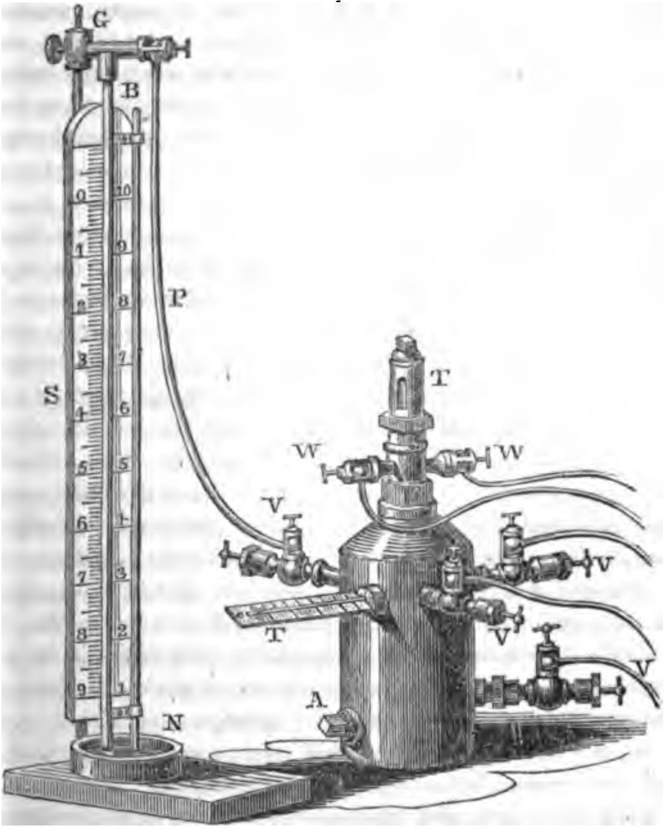
* The reader of the article then published, will excuse some repetition, as otherwise the apparatus in its improved form could not be made intelligible to those who have not seen, or do not remember the explanation then given.

† This is the name by which I have designated it in my text book.



Description of the Gage.

It is well known, that if a vertical glass tube communicate, through its upper orifice, with a receiver, while its lower orifice is situated beneath the surface of an adequate quantity of mercury, in any convenient receptacle; on exhausting the receiver, the metal will rise in the bore of the tube in proportion to the quantity of air removed. Hence, if zero of the ascending column of degrees, counting upwards from one to ten, be placed on a level with the surface of the mercury in the receptacle at the foot of the gage tube G, the quantity of gas liquefied or withdrawn will be as the number of degrees opposite the surface of the column of the mercury in the gage tube.

Again, supposing it were possible to exhaust the vessel perfectly, the column of mercury in the gage, would attain the height of a well filled Torricellian tube. By having such a tube by the side of the gage tube, as represented at B in the figure, its orifice communicating with the mercury of the same receptacle, and placing zero of the descending column of graduations on a level with the surface of the mercury in the Torricellian tube, the quantity of air in the receiver will always be as the number of degrees, between the surface of the mercury in the gage and the surface of the same metal in the Torricellian tube.

The scale comprises ten divisions, each containing ten subdivisions. The whole scale may therefore be estimated to divide the capacity of a receiver into ten volumes, or into one hundred, whenever the zeros of the right and left hand columns of degrees coincide simultaneously, the one with the surface of the mercury in the receptacle, and the other with that of the Torricellian column. But on this it were vain to rely, since the altitude of the Torricellian column is liable to vary while the scale remains unchanged. This difficulty is, however, easily surmounted by restricting the length of the graduated part of the scale to the minimum height of the mercurial column, or twenty-seven inches; and employing an excess of hydrogen when the quantity of oxygen is to be ascertained, and an excess of oxygen when the quantity of hydrogen, or hydrogen and carbon, are in question; the excess in either case, being made equal to the difference between twenty-seven inches, and the height of the Torricellian column. With this precaution, the quantities introduced or withdrawn, will always be to each other as the changes which they produce in the column of mercury in the gage tube. The rise of the mercury in the tube, will cause the surface of it in the receptacle D to be lower; but the breadth of this vessel is so great, and the descent of the mercurial surface in it is so inconsiderable, that no error worthy of attention is thus created.

I ought to mention, that the cavity of the gage tube ought to be so small in proportion to that of the receiver, as to create no error worthy of attention.

Description of the Galvano Ignition Apparatus.

An iron cylinder, of about an inch in bore, includes another concentric cylinder, or tube of glass. A platina wire, which, by being made the subject of a galvanic discharge, is employed to ignite the gaseous mixture, occupies the cavity of the glass. Opposite to it, two openings are made in the iron, which serve for windows, enabling the operator to see the progress of the ignition, and consequently, to know when to break the galvanic circuit, in order to avoid fusing the wire.

Method of Operating.

In the engraving, a leaden tube is represented as making a communication between the gage tube and the cavity of the iron bottle, through one of the valve cocks. Let it be supposed that, by means of other valve cocks and tubes, like communications with an air pump, and one or more reservoirs of gas, are under the control of the operator.

In order to analyze the atmosphere, he should have at his command a communication with a bell glass containing, over water, a mixture of five parts of air and three of hydrogen; also with a reservoir of hydrogen.*

These arrangements being made, exhaust the bottles; and admitting two or three volumes of hydrogen, exhaust again. By repeating this part of the process, nothing but hydrogen will remain in the vessel. Let the zero of the descending scale be situated on a level with the surface of the mercury in the gage tube, and then admit eight volumes of the mixture, which will be known to have entered when the surface of the mercurial column has fallen to eight on that scale. All the cocks being closed, ignite the platina wire. The explosion will be known to take place, both by the flash and sharp noise which it produces. As soon as these indications are perceived, the cock communicating with the gage may be re-opened. Nearly three volumes of the mixture will be found to have disappeared, and by the time that the thermometer indicates the temperature to be in statu quo, it will be found that the deficit arising from the combustion will a little exceed that quantity.

In analysing gaseous compounds of carbon with hydrogen, this apparatus may be advantageously employed; due proportions of the carburet and of oxygen gas being previously mingled in an appropriate vessel over water. Suppose, for instance, olefiant gas were in question; one volume of it being mixed with four of oxygen: after the explosion two volumes will be found wanting; because, in one volume of the carburet, there are two of hydrogen and two of carbon vapor. Each volume of the latter, will unite with one of oxygen, without altering its volume. The two volumes of hydrogen will take one of oxygen, and be condensed with it into water. Of course, in lieu of the five volumes introduced, two volumes of carbonic acid, and one residual volume of oxygen will remain.

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* The necessary mixtures are effected either by means of the volumeters or the sliding rod gas measure, of which I published engravings and descriptions in this Journal, vol. 12, page 36, 1827; and in the London Philosophical Magazine for 1828, vol. 32, page 126.

By means of a forcing air pump, of which a description will be given in the next number of this Journal, the gas may be transferred to a receiver, and washed with ammonia, or milk of lime, and then allowed again to enter the iron bottle. Meanwhile, by due attention to the gage, the quantity which has been absorbed may be ascertained; and consequently, the proportion of carbonic acid resulting from the oxidizement of all the carbon in the gas subjected to analysis.

Instead of employing the forcing air pump, by substituting a large valve cock for the screw by means of which an aperture in the bottle at A is closed, mercury may be introduced through a funnel, and, by its pressure, the residual gas may be easily conveyed, by a flexible leaden tube, to a receiver over the mercurial reservoir, and analyzed in the usual way. For this purpose it is necessary that the valve cocks with which the mercury comes in contact, should be of iron or steel; and, accordingly, I employ such where mercury is to be used.

The gases may be supplied, without previous measurement and admixture, by receiving them into the bottle from their respective reservoirs, and measuring them as they enter, by means of the gage.*

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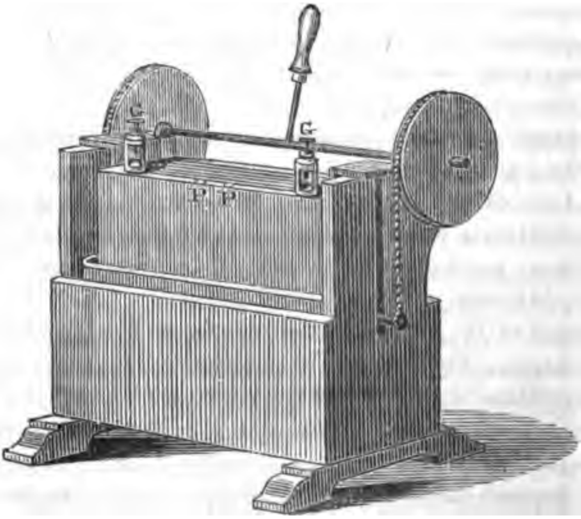
* I subjoin an engraving of the colorimotor, by means of which the ignition of the platina wire, and consequent inflammation of the gaseous mixtures are accomplished.



This engraving will convey an idea of the calorimotor suitable to effect the ignition of the platina wire in the galvano ignition apparatus above described. It

When hydrogen is employed to analyze the air, with the exception of the quantity requisite to adjust the gage as already explained, it should be the last admitted; since otherwise it is liable, from its lightness, to pre-occupy the cavity in which the platina wire is situated; so that some time would be required for its sufficient admixture with atmospheric oxygen to constitute a combustible mixture.

In this mode of operating, when the apparatus is once well arranged, the analysis of the air may be repeated as often as desired, and after any interval of time.

Art. VII.—*Engraving and Description of Voltaic Series, combining the advantages of the trough of Cruickshank with those of the Deflagrator*; by Prof. R. Hare, M. D., &c. &c.

TO THE EDITOR.

Dear Sir—In your last number, an abstract was made from Faraday's researches, agreeably to which my deflagrator, is represented as the best construction, of the voltaic series. It will be recollected, that one principal ground of this alleged superiority is the mechanism by which the acid is thrown on or off of the plates, by a partial revolution of the troughs, containing the series and acid, to the extent of one fourth of a circle.

Subsequently this mechanism, which may be designated as the *quadri-rotary mechanism*, was applied by me to troughs constructed upon the principle of that of Cruickshank, the pairs being made to exist in a greater degree of proximity than had been previously attempted. It is well known that the Cruickshank pair consists of a plate of zinc and a plate of copper, corresponding in size and shape, placed face to face, and soldered together at one or more of their edges. Pairs of this kind, slipped into grooves, in a trough so as to be parallel, formed the Cruickshank trough which took place of the

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should contain two galvanic pairs, each consisting of two plates of zinc, 10 × 12, alternating with three of copper. The copper plates of one pair, and the zinc of the other being soldered to a common metallic strip, the other plates of zinc being soldered to one strip, the copper to another, each of the last mentioned strips is furnished with a gallows screw G G. Between these screws and those at W W, (see figure in the text,) a communication is made by leaden or copper rods.

To complete the circuit, it is only necessary, to depress the handle attached to the pulleys, in order to raise the reservoir of diluted sulphuric acid, and thus to cause it to act on the plates.

couronne des tasses, or *pile* of Volta. The Cruickshank troughs were superseded by Babbington's apparatus, having cells made in troughs of porcelain, or in mahogany troughs with glass partitions, the plates being attached to a bar by which ten or twenty might be lifted at once from the acid, so as to suspend its reaction with the zinc. It is to this characteristic, that the preference given to the last mentioned construction by Davy and others has been ascribed. It occurred to me that the quadri-rotary mechanism, being applied to the Cruickshank trough, would completely obviate the difficulty of suspending the chemical reaction, which had led to the abandonment of this construction of the series, and likewise that the saving which had been alleged to follow from the surrounding of the zinc by copper, could be equally secured by the Cruickshank pairs. As in these the copper and zinc afford reciprocal support, the zinc might be of less than half the thickness requisite in isolated plates, and two of the former might be put in less space than one of the latter. In either case there would be the same surface subjected to oxidizement, since one of the surfaces of each zinc plate in the Cruickshank pairs is protected from the acid. It was ascertained that at least three Cruickshank pairs could be introduced within an inch, so that more surface could be exposed in a given space in this way, than in any other. Since that time a small trough has been constructed in which sixty pairs were introduced within ten inches and a half.

The advantages of this construction are as follows: the association of the two metals into one compound plate, renders them both firmer so as to admit of greater evenness of surface and more exact parallelism, and consequently of greater proximity without contact: the soldering being once made need not be disturbed in order to remove and clean the plates: the communication between the plates of zinc and copper is more ample and less liable to fail.

The method of making the grooves to which I resorted, is as follows; a plough plane must be so arranged as to have the distance between the cutting iron and guide plate equal to that required for the interstices between the plates. A wooden board is to be procured of about from three eighths of an inch to half an inch in thickness, according to the proposed size of the trough, and sufficiently wide, when slit, to form the bottom and sides of a box to contain the pairs. In this board the grooves are made by running the guide plate in one groove, while another groove is made by the cutting iron. Afterwards the board being slit, so as to make the sides and bottom of a box to receive the pairs, the grooves are easily made to correspond. The box being heated as hot as the wood will bear and soaked with melted suet or beeswax, the pairs are slid into the grooves.

To correspond with the outside of the box containing the pairs, the inside of one of two troughs placed side by side, as are those represented in the engraving, having been prepared, the box must be cemented therein by a mixture of one part of suet and seven of rosin. The wood should be heated as hot as possible without taking fire. This may be effected by shavings, by a chauffer of coals, by a flambeau made with spirit of wine, spirit of turpentine, or coal naphtha. By the consequent rarefaction, the pores being nearly vacated of the moisture and air with which they are naturally occupied, on cooling they will imbibe the cement which should be fused and introduced while the heat is at a maximum.

A box without grooves, otherwise similar to that made for the pairs, should be made for the other compartment. Both boxes should be heated on the outside and soaked with cement, and introduced into their places, while hot enough to keep the cement fluid. In troughs thus constructed I have not found the leakage, of which Mr. Faraday complains, to take place. In fact I have made troughs without an inside box, which are made tight simply by tongueing the boards, &c. putting them together with screws and white lead, and then cementing them on the inside as above described.*

I propose in future to have the plates of an oblique form upon one of their sides, so as to be of a lesser width at bottom than at the upper edge. By these means they may easily be slid into their grooves, or removed for cleansing. The use of a membrane, as in Daniel's ingenious apparatus, to prevent deposition on the plates, may be found advantageous, where a permanent supply of voltaic electricity is desirable, and is hypothetically highly interesting, as verifying some of those anticipations arising from Faraday's researches, which led to its construction; but yet I hold that expedient to be inapplicable, in those constructions of voltaic series, which are otherwise most convenient, efficient and compact.

Of the apparatus which I have latterly used, and which I call the Cruickshank deflagrator, I send engravings and descriptions, in some printed pages, abstracted from the Transactions of our American Philosophical Society, Vol. V, Part 3, lately published.

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* The common wood screw is not sufficient. I used screw bolts and nuts, the latter let into the wood. In bringing up the joints a powerful joiner's clamp press was employed.

Galvanic Deflagrator of one hundred pairs, of fourteen inches by eight.

Fig. 1.

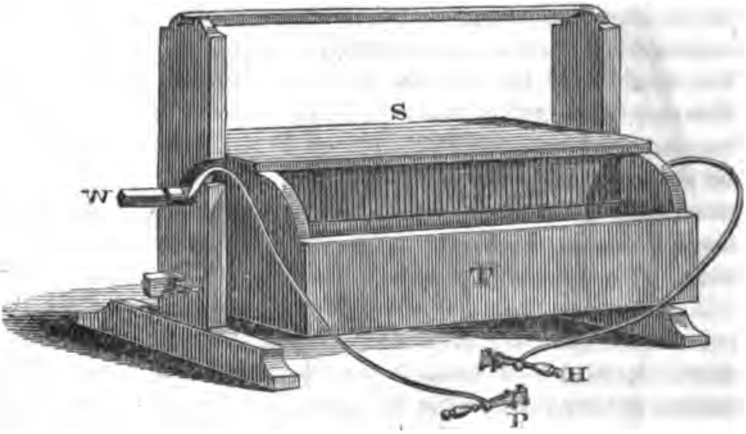

Fig. 1 represents a voltaic series, upon the plan of the trough of Cruickshank, associated with another trough destitute of plates, and of a capacity sufficient to hold all the acid necessary for an ample charge. The trough containing the series is joined to the other lengthwise, edge to edge, so that when the sides of the one are vertical, those of the other must be horizontal. The advantage of this arrangement is, that by a partial revolution of the two troughs, thus united, upon pivots which support them at the ends, any fluid which may be in one trough must flow into the other; and, reversing the movement, must flow back again. The galvanic series being placed in one of the troughs, the acid in the other, by a movement such as above described, the plates may all be instantaneously subjected to the acid, or relieved from it. The pivots are made of iron, coated with brass or copper, as less liable to oxidizement. A metallic communication is made between the coating of the pivots, and the galvanic series within. In order to produce a connexion between one recipient of this description and another, it is only necessary to allow a pivot of each trough to revolve on one of the two ends of a strap of sheet copper. To connect with the termination of the series, the leaden rods, to which are soldered the vices, or spring forceps, for holding the substances to be exposed to the deflagrating power, one

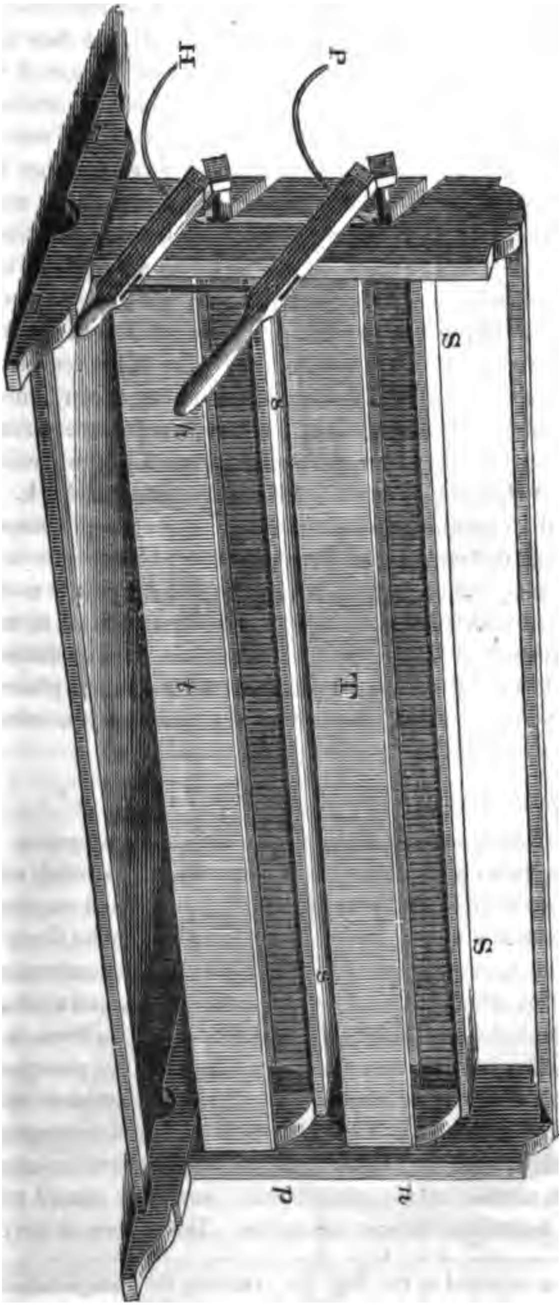

Fig. 2.

Galvanic Deflagrator of seven hundred pairs, of seven inches by three.

end of each of the lead rods is soldered to a piece of sheet copper. The pieces of copper, thus soldered to the lead rods, are then to be placed under the pivots, which are of course to be connected with the termination of the series. The last mentioned connexion is conveniently made by means of straps of copper, severally soldered to the pivots and the poles of the series, and screwed together by a hand-vice. Each pair consists of a copper and a zinc plate, united by solder at the upper edge, where the copper is made to embrace the edge of the zinc. The three remaining edges are made to enter grooves in the wood, being secured therein by cement. For each inch in the length of the trough there are three pairs. In the series represented by fig. 1, there are one hundred pairs of fourteen inches by eight; in that represented by fig. 2, there are seven hundred pairs of seven inches by three. The latter will deflagrate wires too large to be ignited by the other, but is less powerful in producing a jet of flame between the charcoal points, or in giving a shock.

Fig. 2, on the opposite page, represents a series which comprises two Cruickshank deflagrators, so constructed as to co-operate in one circuit by an adequate communication between their poles, and being so associated with a lever, as to be made, by means of it, to revolve simultaneously. They may be made to act either collaterally, as a series of 350 pairs, or consecutively, as 700. As the plates are seven inches by three, when used collaterally, they are equivalent to 350 plates of seven inches by six.

Combustion of Phosphorus in nitrous oxide gas.[*]

There is a striking backwardness in the oxides of nitrogen to part with their oxygen to phosphorus, until it be intensely ignited, either by an incandescent iron, or by the access of uncombined oxygen.

This characteristic in the case of nitrous oxide, may be illustrated by means of an apparatus like that employed for the combustion of phosphorus in oxygen with a tall cylindrical receiver, and a tube descending through the neck, and along the axis of the receiver, terminating in a capillary orifice over the cup for holding the phosphorus. The upper end of the tube, outside the receiver, is furnished with a cock, to which a gum-elastic bag inflated with oxygen is attached.

Under these circumstances, the receiver having been exhausted, and filled with nitrous oxide; phosphorus, previously placed within the cup, may be melted without taking fire. But as soon as the cock communicating with the bag of oxygen is opened, an intense combustion ensues; since the oxygen, emitted in a jet from the capillary orifices of the tube, reaching the melted phosphorus excites it into an active combustion, which the nitrous oxide afterwards sustains with great energy.

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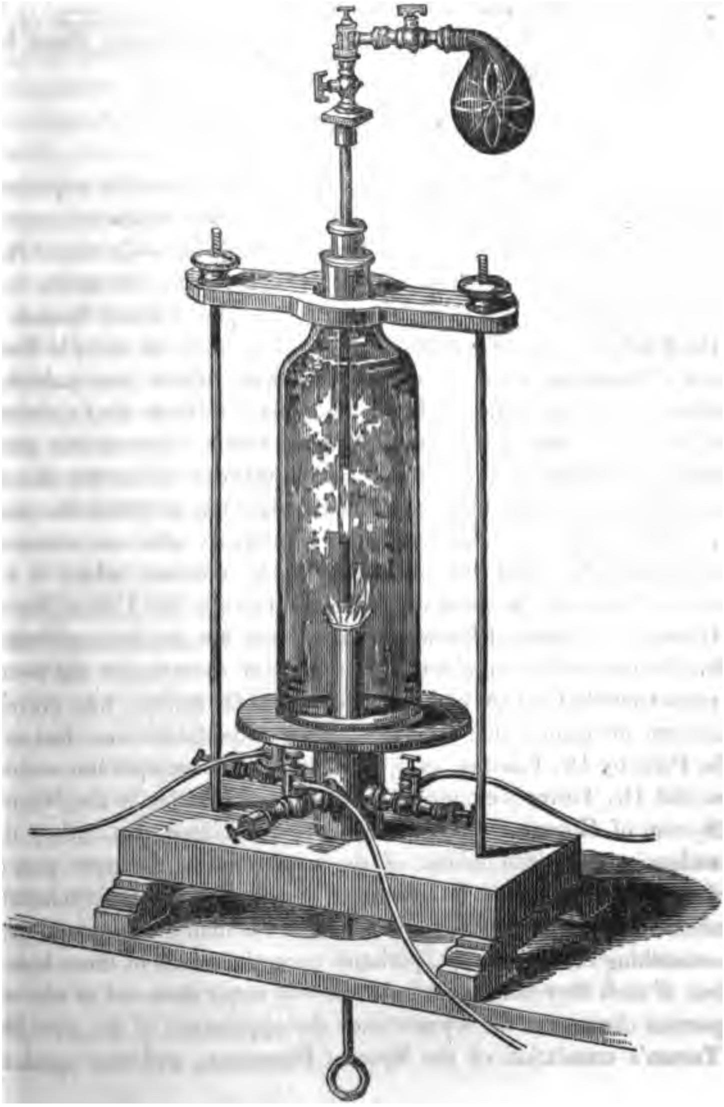
[*] An apparatus employed by Dr. Hare for exhibiting the same peculiarity in the case of nitric oxide has already been published in this Journal.

Combustion of Phosphorus in Nitrous Oxide illustrated.



Art. VIII.—*A Natural System of Botany; or a systematic view of the Organization, Natural Affinities, and Geographical Distribution of the whole Vegetable Kingdom; together with the uses of the most important species in Medicine, the Arts, and rural or domestic economy;* by John Lindley, Ph. D. &c. *Second edition, with numerous additions and corrections, and a complete list of genera, with their synonyms.* London: Longman, Rees, &c. 1836. pp. 526. 8vo.

(Communicated for this Journal.)

The cultivators of Botany in this country are generally acquainted with the former edition of this work through the American reprint, edited by Dr. Torrey, and published by the Messrs. Carvill of New York, in the spring of 1831. Dr. Lindley's treatise was at the time of its appearance, the only introduction to the Natural System in the English language, if we except a translation of Achille Richard's *Nouveaux Elemens de la Botanique*, which was published about the same period. It is unnecessary to state that a treatise of this kind was greatly needed, or to allude either to the peculiar qualifications of the learned and industrious author for the accomplishment of the task, or the high estimation in which the work is held in Europe. But we may very properly offer our testimony respecting the great and highly favorable influence which it has exerted upon the progress of botanical science in the United States. Great as the merits of the work undoubtedly are, we must nevertheless be excused from adopting the terms of extravagant and somewhat equivocal eulogy employed by a popular author, who gravely informs his readers that no book, since printed bibles were first sold in Paris by Dr. Faustus, ever excited so much surprise and wonder as did Dr. Torrey's edition of Lindley's Introduction to the Natural System of Botany. Now we can hardly believe that either the author or American editor, of the work referred to, were ever in danger, as was honest Dr. Faustus, of being burned for witchcraft; neither do we find any thing in its pages calculated to produce such astonishing effects, except, perhaps, upon the minds of those botanists, if such they may be called, who had never dreamed of any important changes in the science since the appearance of the good Dr. Turton's translation of the Species Plantarum, and who speak of

Jussieu as a writer who "has greatly improved upon the natural orders of Linnæus."* We have no hesitation, however, in expressing our conviction that no single work has had such a general and favorable influence upon the advancement of botanical science in this country, as the American edition of Dr. Lindley's Introduction to the Natural System. This treatise, however useful, was indeed not absolutely indispensable to the favored few, who, aided by the works of Jussieu, Brown, De Candolle, the elder and younger Richard, &c. were already successfully and honorably pursuing their investigations; but to the numerous cultivators of botany throughout the country, who could seldom be expected to possess, or have access to, well furnished libraries, and to whom the writings of these great luminaries of the science were mostly unknown except by name, this publication was a truly welcome acquisition, conferring advantages which those alone who have pursued their studies under such unfavorable circumstances can fully appreciate.

A second and greatly improved edition of this work having appeared within the past year, it occurred to the writer of these remarks, that a cursory notice of it might not be unacceptable to the readers of the American Journal of Science. We do not intend, in these observations, to engage in a defense of what is called the Natural System of Botany; but take it for granted, that the science can by no other method be successfully and philosophically pursued: or, to employ the forcible language of Linnæus, "*Methodus naturalis primus et ultimus finis botanices est et erit,*"......"*Primum et ultimum in hoc botanicis desideratum est.*" The few persons who remain at this day unconvinced of its advantages are not likely to be affected by any arguments that we could adduce. A somewhat larger number may perhaps be found in this country who admit the importance and the utility of a natural arrangement in the abstract; but decline to avail themselves of the advantages it affords in the study of plants, because, forsooth, it is too much trouble to acquire the enlarged views of vegetable structure which are necessary for the application of its principles. It would almost seem, from the views and practice of such botanists, that they considered it the chief object of a classification to afford the means of ascertaining the name of an unknown plant by the slightest examination of its structure, and with the least possible expenditure of thought.

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* Dr. Lindley is quite right in his remark that the chief difficulties the student has to encounter in the study of botany, upon the principles of the Natural System, have been very much exaggerated by persons who have written upon the subject without understanding it. To refer to a single instance. In the fifth edition of the Manual of Botany, by Mr. Eaton, an account of the Natural Orders of Jussieu is given, in which the genera Ambrosia and Xanthium are referred to Urticeæ; and in a note it is added, "*Some botanists place the last two genera in the order Corymbiferæ, also in the Linnæan class Syngenesia. I see no good reason for these innovations.*" Now Linnæus, in his artificial arrangement, certainly did place these genera (and also Parthenium and Iva,) in Monœcia Pentandria; but the *innovator* in this instance, is Jussieu himself, who never referred these two genera to Urticeæ, but places them in his order *Corymbiferæ*, (Compositæ,) where they truly belong. The descriptions of Natural Orders in Eaton's Manual, purporting to be taken from Jussieu, bear a very remote resemblance indeed to the ordinal characters of the admirable *Genera Plantarum* of that author, while the occasional criticisms on its supposed errors afford the clearest proof that the work was not understood by the author alluded to. It should be recollected that, previously to the reprint of Dr. Lindley's Introduction, Mr. Eaton's Manual was the only work professing to give a view of the Natural System, within the reach of the great majority of the botanical students of this country, excepting, perhaps, the American edition of Smith's *Grammar* of *Botany*.

In the first edition, Dr. Lindley entered into some detailed explanations to show the fallacy of the common opinion that the artificial system of Linnæus is easy, and the Natural System difficult of application. The sentiments of the public having undergone so great a change upon this subject within the last five or six years, that he finds it no longer necessary to adduce these considerations, and accordingly commences at once with a developement of the principles on which the Natural System is founded, viz. "That the affinities of plants may be determined by a consideration of all the points of resemblance between their various parts, properties, and qualities; that thence an arrangement may be deduced in which those species will be placed next each other which have the greatest degree of relationship; and that consequently the quality or structure of an imperfectly known plant may be determined by those of another which is well known. Hence arises its superiority over arbitrary or artificial systems, such as that of Linnæus, in which there is no combination of ideas, but which are mere collections of isolated facts, not having any distinct relation to each other."—(*Preface, p.* vii.)

We have never met with a more clear and succinct account of the principles on which the primary divisions of the vegetable kingdom rest, than that comprised in the following extract. Those acquainted with the first edition will perceive that the author has changed his opinions respecting the number of these primary divisions, or classes; the *Gymnospermæ*, or Flowering plants with naked ovules (comprising the Coniferæ, Cycadeæ, and, according to Brongniart and Lindley, the Equisetaceæ,) and the *Rhizanthæ*, as originally established by Blume, being here admitted to the rank of independent classes. Their claim to this rank, however, can as yet be hardly considered as fully established.

"One of the first things that strikes an enquirer into the structure of plants, is the singular fact, that while all species are capable of propagating their race, the mode in which this important function is accomplished is essentially different in different cases. The great mass of plants produce flowers which are succeeded by fruits, containing seed, which is shed or scattered abroad, and grows into new individuals. But in Ferns, Mosses, Mushrooms, and the like, neither flowers, nor seeds properly so called, can be detected; but propagation is effected by the dispersion of grains or spores which are usually generated in the substance of the plant, and seem to have little analogy with true seeds. Hence the vegetable world separates into two distinct groups, the *Flowering* and the *Flowerless*. Upon examining more closely into the respective peculiarities of these two groups, it is found that flowering plants have sexes, while flowerless plants have none; hence the former are called *Sexual*, and the latter *Asexual*. Then again the former usually possess a highly developed system of spiral or other vessels, while the latter are either altogether destitute of them, or have them only in the highest orders, and then in a peculiar state: for this reason flowering plants are also called *Vascular*, and flowerless *Cellular*. More than this, all flowering plants, when they form stems, increase by an extension of their ends and a distention or enlargement of their sides; but flowerless plants appear to form their stems simply by the addition of new matter to their points; for this reason while the former are principally *Exogens* or *Endogens*, the latter are called *Acrogens*. Flowering plants are also for the most part furnished with respiratory organs or stomates, while flowerless plants are to a great extent destitute of them. No one then can doubt that in the vegetable kingdom, two most essentially distinct divisions exist, the *Flowering* and the *Flowerless*, and that these differ not in one circumstance only, but are most essentially unlike in many points both of organization and physiology.

"In like manner, *Flowering plants* are themselves divisible into equally well marked groups. Some of them grow by the addition of new woody matter to the outside of their stem beneath the bark; these are *Exogens*: others grow by the addition of new woody matter to the inside of their stem near the centre; those are *Endogens.* But Exogens have two or more cotyledons to their embryo, and hence are called *Dicotyledons;* while Endogens have only one cotyledon, and are, therefore, *Monocotyledons.* Exogens have the young external wood connected with the centre by medullary processes; Endogens having no occasion for such a provision, are destitute of it. In Exogens the leaves have their veins disposed in a netted manner; in Endogens the veins run parallel with each other. The number of parts in the flower of an Exogen is usually five, or its multiples; in an Endogen it is as usually three, or its multiples. In germination the young root of Exogens is a mere extension of the radicle; but of Endogens it is protruded from within the radicle; hence the former have been named *Exorhizæ,* and the latter *Endorhizæ.* In this case then, as in the last, we have two groups differing entirely from each other in their germination, the structure of their stem and leaves, their mode of growth, the arrangement of the parts of the flower, and in the organization of their embryo. It is impossible, therefore, not to recognize such groups also as natural.

"To this separation of the vegetable kingdom into Exogens, Endogens, and Acrogens, or by whatever synonymous names these groups may be known, many botanists confine themselves. But there are two others, of subordinate importance perhaps, but nevertheless characterized by circumstances of a similar nature, and, therefore, I think, to be esteemed of equal dignity with them. In true Exogens and Endogens, the fertilizing principle is communicated to the young seeds through the medium of a stigma which terminates a case or pericarp in which they are enclosed. But in some plants otherwise Exogens, the fertilizing principle of the pollen is applied immediately to the seeds, without the intervention of any pericarpial apparatus, and they bear the same relation to other Exogens as frogs and similar reptiles to other animals. These plants, therefore, are separated as a distinct class, under the name of *Gymnosperms.* Like the other groups of the same grade, these are also found to possess peculiarities of a subordinate nature. For instance, they have in many cases more cotyledons than two, whence they have been called *Polycotyledons;* their radicle usually adheres to the albumen in which the embryo lies, and that circumstance has given rise to the name *Synorhizæ.* The veins of their leaves, when they have any veins, are either simple or forked; in which respect they approach Endogens on the one hand, and Acrogens on the other.

And finally, their vascular system is very imperfect compared with that of other Exogens of an equal degree of development.

The other group, called *Rhizanthæ*, is far less correctly known, but it seems to stand as it were between Endogens and Acrogens of the lowest grade; agreeing with the latter in the absence or very imperfect state of the vascular system, in a general resemblance to Fungi, and in the apparent seeds being mere masses of sporules; but apparently according with Endogens in the ternary number of their floral envelopes, and in the presence of fully developed sexes.

"Certainly there is no possibility of obtaining such important primary groups as these by any kind of artificial contrivance."—(*Preface, p.* x.—xii.)

The grand natural divisions of the vegetable kingdom are, therefore perfectly obvious, and may be very clearly defined. With our present knowledge of vegetable structure no great difficulty is experienced in characterizing the orders or natural families, and all subordinate groups. The great desideratum has ever been to effect such an arrangement of the orders under the primary classes, that each family should be placed next to those which it most nearly resembles. This might easily be accomplished, if the idea once so strongly insisted upon by poets and metaphysicians, of a chain of beings, a regular gradation, by a single series, from the most perfect and complicated to the most simple forms of existence, had any foundation in truth. On the contrary, nothing is more evident, than that almost every order, or other group, is allied not merely to one or two, but often to several others, which are sometimes widely separate from each other; and, indeed, these several points of resemblance or affinity, are occasionally of about equal importance. A truly natural lineal arrangement is therefore impracticable, since by it only one or two out of several points of agreement can be indicated. As this method is, however, the only one that can be followed in books, all that can be done is to arrange the orders in such a manner as to offer the least possible interruption to their natural affinities. The number of orders is so large that practical convenience seems to require their arrangement into groups subordinate to the primary classes; and when manifestly natural assemblages cannot be recognized, we are obliged to employ those which, being less strongly marked, and distinguished by a smaller number of characters, are apparently of a more artificial nature. The arrangement employed by the learned Jussieu, in his celebrated *Genera Planta-*

rum, although to a considerable extent artificial, has been almost universally adopted, until within the last few years.

In this method Dicotyledonous plants are primarily divided into three groups; the first including those with a polypetalous corolla; the second, those with a monopetalous corolla; and the third, those destitute of a corolla. These sections are subdivided, (as also the monocotyledons) by means of characters taken from the insertion of the stamens (or corolla,) whether hypogynous, perigynous, or epigynous. The arrangement here pursued, which is too well known to require further notice, is substantially adopted by De Candolle, the difference being more in appearance than reality. Dr. Lindley discarded these subdivisions in the first edition of his work; but the new distribution of the orders therein proposed possesses few advantages, and, indeed appears not to have satisfied the author himself. In the same year with the publication of the work just mentioned, the *Ordines Plantarum* of Bartling appeared, in which a more natural arrangement of the orders is attempted by the formation of aggregate or compound orders, as originally proposed, and in several instances successfully accomplished, by Robert Brown. An analogous plan was pursued by Agardh in his *Aphorismi Botanici*, (1817,) and again in his *Classes Plantarum*, (1825;) but these attempts, however ingenious, do not seem to have obviated, in any considerable degree, the inconveniences of a lineal arrangement.

We now return to our author, whose views upon this subject have been materially modified since the original publication of his Introduction to the Natural System. The method now employed was first sketched in the *Nixus Plantarum*, (1832,) and afterwards in the *Key to Structural, Physiological, and Systematic Botany*,* (1835,) and is more fully developed and illustrated in the work before us. He now admits, as we have already seen, five primary classes, two of which, however, are much smaller than the others and of subordinate importance, and may be considered as transition classes, viz. *Gymnospermæ*, which connect Exogens with the higher Acrogens, and *Rhizanthæ*, which form the transition from Endogens to Acrogens of the lowest grade. The great class *Exogenæ* (*Dicotyledones* of Jussieu,) is divided into three subclasses, viz.

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* This excellent little work consists of an augmented edition of the author's *Outlines of the first principles of Botany*, with a revised translation of the *Nixus Plantarum*.

1. *Polypetalæ;* those with the floral envelopes consisting of both calyx and corolla, the latter composed of distinct petals.

2. *Monopetalæ;* those with the petals combined in a monopetalous corolla.

3. *Incompletæ;* those always destitute of a corolla, the calyx also often incomplete or absent.

Thus far this mode of subdivision is nearly the same with that of Jussieu; Dr. Lindley, however, neglecting altogether the characters afforded by the insertion of the stamens, divides the polypetalous orders into seven, and the monopetalæ and incompletæ each into five sections, or *groups*. As a specimen of this plan, we copy the names of the groups of the first subclass, with their synoptical characters.

1. *Albuminosæ.* Embryo very considerably shorter and smaller than the albumen.

2. *Epigynosæ.* Ovary inferior, usually having an epigynous disk.

3. *Parietosæ.* Placentation parietal.

4. *Calycosæ.* Calyx incompletely whorled; two of the sepals being exterior.

5. *Syncarposæ.* None of the characters of the other groups, and with the carpels compactly united.

6. *Gynobaseosæ.* Carpels not exceeding five, diverging at the base, arranged in a single row around an elevated axis or gynobase. Stamens usualy separate from the calyx.

7. *Apocarposæ.* None of the characters of the other groups, but with the carpels distinct, or separable by their faces, or solitary.

Next, every group is divided into smaller groups, each of which includes one, two, or several orders. These minor groups are called *Alliances*, and are distinguished by the termination *ales*. Thus, under the Albuminose group, we have

Alliance 1. *Ranales*, comprising the Ranunculaceæ, Papaveraceæ, (with its suborder, as Lindley, following Bernhardi, considers it, Fumarieæ,) Nymphæaceæ, (to which Hydropeltideæ is improperly joined,) and Nelumbiaceæ;

Alliance 2. *Anonales*, which comprehends the Nutmeg tribe, the Anonaceæ, Magnoliaceæ, &c.;

Alliance 3. *Umbellales*, including the Umbelliferous tribe, with the nearly allied Araliaceæ;

Alliance 4. *Grossales*, consisting chiefly of the Grossulaceæ or Currant tribe; and lastly

Alliance 5. *Pittosporales*, which strikes us as a singularly heterogeneous assemblage, bringing together into one group the Vitaceæ, Pittosporaceæ, Olacaceæ, Francoaceæ, and Sarraceniaceæ!

All the subclasses and groups, both of Exogens and Endogens, are subdivided in a similar manner; but we cannot here proceed further with our enumeration. It will be borne in mind that the chief object of an arrangement of this kind, is to facilitate the study of the natural orders, by dividing the extensive primary classes into sections of convenient size, and to dispose these groups, and the orders they comprise, as nearly in accordance with their respective affinities and relationships as a lineal arrangement will allow. It is impossible, in the present state of our knowledge, to say how far the views of our author will ultimately be approved. Every attempt of the kind must necessarily be very imperfect, so long as the structure of only a limited portion of the whole vegetable kingdom has been attentively and completely examined; and the author is well aware "that this part of the work will require many great changes and improvements before it can be considered at all established." Notwithstanding the objections to which it is liable in many particulars, we agree with the author in the opinion, "that even in its present state it will be found to be attended with numerous advantages, and that every step which may be taken in determining the limits of natural groups subordinate to the primary classes, must be a decided gain to the science. So rapid is the advance of our knowledge of the vegetable kingdom, and so numerous are the new types of structure that present themselves to the systematic botanist, that it is to be feared lest another chaos should be brought on by the masses of imperfectly grouped species with which the science will soon abound."

The names of natural orders, as first established, do not appear to have been framed in accordance with any uniform rule, as to derivation or mode of termination. They were sometimes intended to express some characteristic feature, (Ex. *Leguminosæ*, *Labiatæ*, *Cruciferæ*, *Umbelliferæ*, *Coniferæ*, &c.) but more commonly some genus was selected as the type of the family, which was designated either by the plural of the genus simply, (as *Myrti*, *Lilia*, *Irides*, *Euphorbiæ*,) or with a slight prolongation, (as *Orchideæ*, *Jasmineæ*, &c.) or with the termination still further modified, (as in *Cyperoideæ*, *Aroideæ*, *Boragineæ*, or *Ranunculaceæ*, *Rosaceæ*, *Cucurbitaceæ*, &c.) The derivation of the name of an order from some prominent genus is now the universal practice; and for the sake of uniformity, as well as to distinguish such names from those of genera in the plural number, the termination *aceæ* is given to orders, and that of *eæ* to suborders, &c. The advantages of uniformity in this respect are manifest, and Dr. Lindley therefore insists upon the adoption of the rule in all cases. In the *Key to Botany*, published the year previous to the appearance of the second edition of the present work, the termination in *aceæ* is employed, not only in names of orders formed from those of genera, but also in the few still in use which relate to some peculiarity in the habit of the family. Thus, instead of Cruciferæ, Umbelliferæ, Coniferæ, &c. we have *Cruciaceæ*, *Umbellaceæ*, and *Conaceæ*. These are, however, very properly abandoned in the work before us, in which the author inclines to give up the old and familiar names of these orders, and to substitute those formed in the customary manner from well known genera. *Brassicaceæ*, *Apiaceæ* and *Pinaceæ* may certainly be as good names as any other when we once get accustomed to them, but it seems hardly necessary to make any change in the case of names of this kind. Dr. Lindley, as we have already seen, gives to the names of Alliances the termination *ales*, and to the groups that of *osæ*. The chief advantage of this system is, that the name of any group at once indicates its rank and importance.

The value of this work is greatly increased by the complete list of genera, (so far as known at the time of its publication,) with the principal synonyms, appended to each order and properly arranged under their several sub-orders, sections, &c. This laborious and difficult task is upon the whole very faithfully executed. We observe, however, several errors, typographical and otherwise, which are not noticed in the appendix, and in a few instances the same genus is referred to two different orders. The whole catalogue will doubtless be rendered more perfectly accurate in a future edition.

The whole number of genera comprised in this enumeration, exclusive of synonyms, is 7840. Sprengel's *Systema Vegetabilium*, which was finished in 1827, contains (exclusive of the appendix) only 3593 genera, or not quite half the number now known; while the 12th edition of *Systema Naturæ* (the last of Linnæus himself) comprises 1228 genera, or only about a third more than are now known in a single family.

This great and rapid increase is perhaps chiefly owing to the discovery of new plants; but it is also attributable in a good degree to the more accurate knowledge of those already known. In either case, it is the natural result of the progress of discovery; and instead of embarrassing the student, as is often supposed, does in reality render the study of the science much more clear and satisfactory.* Notwithstanding the great increase of genera within the last few years, it may be safely said that at no previous period could a really useful knowledge of the vegetable kingdom be acquired with so little labor. In hazarding this remark, it is of course taken for granted that the student will avail himself of all the advantages of modern physiological botany and of the natural system: for so rapid has been the discovery of new and strange forms of structure, for which the artificial arrangement of Linnæus makes no provision, that the student who takes that system as his guide has indeed a hopeless task before him.

The essential characters of the orders appear to have been very carefully revised in this edition, as also the remarks upon their affinities, geographical distribution and sensible properties. Did our limits allow, we might call the attention of our readers more particularly to this part of the work. We cannot bring our remarks to a close, however, without suggesting what we consider a very desirable improvement upon the manner in which the seed is described not only in this, but in almost all modern systematic works. It is very necessary that an organ which affords such important characters, both as to its situation in the fruit, and particularly as to its internal structure, should be described with the greatest possible clearness and precision, and in an uniform manner. The prevalent fault of which we complain is thus noticed, as long ago as the year 1811, by that most acute botanist, the late L. C. Richard.

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* This remark rests upon the supposition that proposed genera are clearly distinguished from their allies by essential differences of structure, and are not such genera as those often proposed by Mr. Rafinesque, or Mr. Spach. (Vid. *Ann. Sci. Naturelles*, New Ser. *vol.* 4.) We cannot avoid here noticing a remark in Mr. Eaton's Manual of Botany, (ed. 7, p. 84,) intended as a severe criticism upon one of the most eminent botanists of the age. After giving, from De Candolle's Prodromus, the character of the genus *Enemion* (in which "antheris subrotundis" is translated "*with rough anthers*") the author subjoins—"*A doubtful genus; but De Candolle requires very little authority for a new genus.*" Now the genus Enemion was established by Rafinesque, upon what is now well known to be a species of *Isopyrum*; and De Candolle, who never saw the plant of Rafinesque, but merely copies his published description, prefixes the mark of a doubtful genus, and remarks that it seems to be the same as Isopyrum! The critic who could hazard such a remark must have presumed that the *Prodromus* of De Candolle was not likely to fall into the hands of his readers.

"Cæsalpinus, Adanson, Jussieu, and Gærtner, always take into view the direction of the embryo relative to the pericarp merely. This method appears to me improper; first, because it does not indicate with precision that direction which is most important to be understood; secondly, because the *pericarpic* direction of the embryo is often difficult to be ascertained, and is sometimes variable or even wholly different in the seeds of the same fruit. I have already shown by numerous examples in my *Analyse du fruit*, that the best method is to indicate the direction of the *seed* relative to the pericarp, and of the *embryo* relative to the seed."*

In very many descriptions, the direction of the embryo relative to the seed can only be inferred from the *pericarpic* direction, or which is still more objectionable, the same structure is described by very different language in different instances, thus rendering unnecessarily complicated an investigation which of itself is not usually difficult. We may adduce as an example the five orders comprised in the alliance *Ranales*, which stands at the commencement of Dr. Lindley's treatise. We have no means of ascertaining, from the essential character of any one of these orders, either the *spermic* direction and position of the embryo, or the situation of the chalaza and micropyle relative to the hilum, from which the former may be inferred. It is commonly stated that the embryo is situated at the base of the albumen; but it is not specified whether the radical is next the hilum, (as in Papaveraceæ, Nymphæaceæ, &c.) or points in the opposite direction, (as in Nelumbiaceæ and Cabombaceæ;) a matter of essential importance, since the seeds result in the one case from the ripening of *anatropous*, and in the other of *orthotropous*, ovules.

The students of botany in this country are greatly indebted to the learned editor and the enterprising publishers of the first American edition of this work. May we hope to have our obligations increased by the reprint of this greatly improved edition? A. G.

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* Ann. Du Museum, vol. 17, p. 446.

ART. IX.—*Electro-Meteorological Observations;* by JAS. SWAIM.

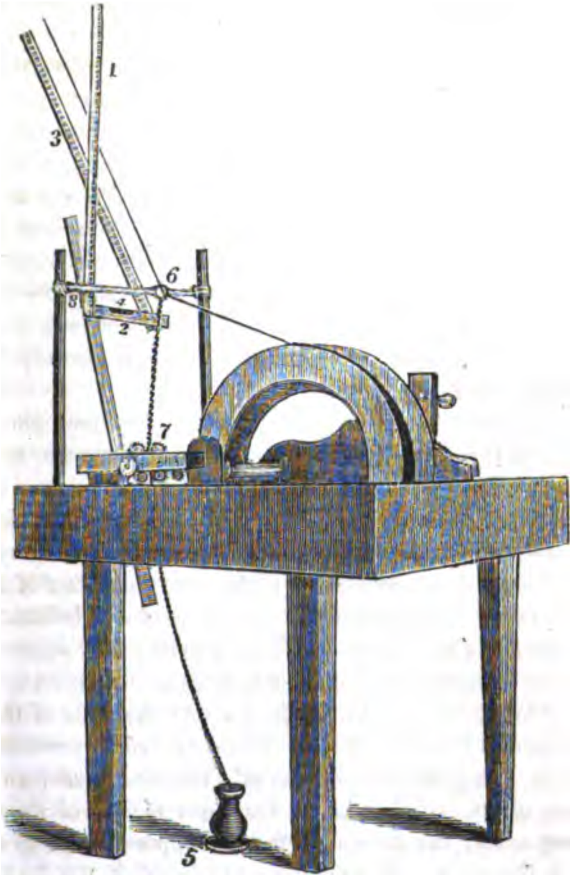
1836.	Dry thermometer.	Wet thermometer.	Dew point.	Barometer.	Perpendicular height of the kite when the leaves of the electrometer touch the side.	Length of wire out.	Wind.—Lower current.	Wind. Upper and middle current.	State of Weather, &c.
P. M. *h. m.*									
Oct. 23.	61.50	53.00	44.99	30.17			S. W.	W. by N.	Clear—clear.
" 24.—4	67.00	57.00	48.76	30.25	276	308	S. E.—S. W.	W. by N.	Clear—clear.
" 25.	43.50	36.00	22.05	30.29			N.	Clear.	Clear—clear.
" 26.—3 30	45.00	36.50	21.02	30.20	55	60	W.—N. W.	W.	Clear—cloudy.
" 27.	40.50	36.00	27.63	29.76			N. W.	W.	Cloudy—cloudy.
" 28.—4	46.00	39.00	27.52	30.05	44	52	S —N. W.	Clear.	Clear—cloudy.
" 29.	51.50	42.50	29.69	29.93			N. W.	N. W.	Hazy—cloudy.
" 30.	42.50	38.50	31.80	29.22			N. by E.	W.	Light clouds—cloudy.
" 31.	40.50	35.00	24.32	29.34			E.	Clear.	Clear—cloudy.
Nov. 1.	48.00	43.00	36.03	29.14			N. N. E.	Clear.	Clear—clear.
" 2.				29.69			N. N. E.	N. N. E.	Cloudy—rain.
" 3.	45.50	40.50	32.79	29.84			N. W.	N. W.	Cloudy—clear.
" 4.—2 30	44.00	37.50	26.15	30.20	127	158	W.—N. W.	N. W.	Cloudy—clear.
" 5.—2 45	40.00	34.00	21.83	30.25	74	84	W.—N. W.	N. W.	Partially cloudy—cloudy.
" 6.	43.00	38.00	29.45	30.04			W. S. W.	Clear.	Cloudy day.
" 7.	51.00	43.50	33.25	30.09			S. W.	W. S. W.	Cloudy day.
" 8.	51.50	46.00	39.19	30.14			N. W.	Clear.	Cloudy—hazy.
" 9.—3 40	53.00	47.75	41.68	30.65	58	68	N. E.—E. N. E.	W. by N.	Clear—cloudy.
" " 3 50	52.25	48.00	43.13	30.65	82	112	N. E.—E. N. E.	W. by N.	
" " 4 7	53.50	49.00	44.04	30.65	151	266	N. E.—E. N. E.	W. by N.	
" 10.—2 35	54.50	50.25	45.79	30.57	476	700	E.	E. by S.	Clear, cloudy, rain at night.
" 11.	65.00	61.00	58.25	30.07			S. by E.	S. by W.	Cloudy—rain.
" 12.—3 25	62.25	58.50	55.65	30.05	136	200	W.—N. W.	S. W.	Clear day.
" 13.	50.00	44.00	35.96	30.02			N. N. W.	W. by S.	Clear day.
" 14.				29.80			E. N. E.	E. N. E.	Rainy day.
" 15.	46.00	42.20	36.75	29.90			N. by W.	S. by W.	Cloudy—clear.
" 16.	44.50	40.00	32.92	29.88			N. W.	W.	Cloudy—clear—rain.
" 17.	42.50	38.00	30.31	30.19			N. W.	N. W.	Clear—flying clouds.
" 18.	43.50	38.50	30.13	30.37			N. by W.	Clear.	Clear day.
" 19.	40.50	36.00	27.63	30.50			N. E.	W. S. W.	Clear day.
" 20.	51.50	48.50	45.13	30.21			N. E.	S. W.	Partially cloudy.
" 21.—3 10	58.50	55.00	51 95	29.95	415	564	N. W.—W.	W. S. W.	Rain—flying clouds.
" 22.—3 20	47.50	45.00	41.78	30.15	111	140	W.	Clear.	Clear—flying clouds.
" 23.—4 25	36.50			29.85	65	92	W.	W.	Clear—cloudy.
" 24.—2 45	41.00	38.50	34.32	29.08	134	148	W.—W. by S.	W. by N.	Clear—snow squalls.

The preceding experiments were made with common three stick kites two feet six inches long and two feet four inches wide, tapering from the middle to the top. Wire No. 30 was used, which was wound on a reel four feet in circumference, having a glass axle running on a frame about three feet high, which was made in the same manner as the one used by the Franklin Kite Club of Philadelphia.

An electrometer (5.) was connected with an iron ring (6.) through which the wire passed, and which was suspended by means of silk, in front of the reel for the purpose of preventing the wire from running off in winding up rapidly.

Also an instrument was used for finding the height of the kite, which I constructed in the following manner. Two stationary arms

(1. and 2.) of different lengths, were placed at right angles. The longer of these (1.) was graduated into small equi-distant divisions. A movable arm (3.) which was graduated in the same manner, was attached to the short arm, into which was let a bevel, (4.)



This instrument was attached to the front of the reel stand by means of a screw (8.) on which it could move.

As soon as the kite was sufficiently elevated to produce an expansion of the electrometer leaves, the instrument was adjusted until the small arm became level, and the movable arm was raised until it was parallel with the wire.

Then as the number of divisions on the movable arm was to the length of wire out, so the number of divisions on the stationary arm should be to the perpendicular height of the kite, or that portion of the lower surface of the positive electricity which was concentrated enough to expand the leaves of the electrometer. The bag or curve of the wire was so small that it was not calculated; a small allowance might probably be made when the length exceeded three hundred feet.

The length of wire out was determined by cog wheels, (7.) with a dial and hand to indicate the number of revolutions made by the reel, which cog wheels were placed on the end of the axle opposite to that on which the handle was placed. The height of the barometer and dew point was also taken at the moment when the expansion of the electrometer leaves took place. The dew point was found from the following formula discovered by Mr. Espy. Take two thermometers (Fahrenheit) that agree, or allow for the difference, cover one of the bulbs with a wet rag, and suspend them in the shade where there is a draft of air, or fan them briskly until they become stationary.

Then the difference of the thermometers being multiplied by one hundred and three, the product divided by the number of degrees indicated by the wet bulb and the quotient subtracted from the number of those indicated by the dry one, will give the dew point.

May not the aurora borealis and australis be produced by the approach of the positive electric fluid of the air to the surface of the earth?

At the poles these phenomena are frequent and brilliant; but as we approach the moist latitudes of the equator, they diminish in frequency and brilliancy, and appear only when the dew point is very low.

It therefore follows that it requires a very dry state of the atmosphere to permit their formation. The preceding experiments, as far as they go, strengthen the opinion of Franklin,* Hare† and others, that there exists, at all times, in the upper regions of the air, or in space beyond it, the electric fluid in an opposite state to that contained in the earth. They also tend to establish the doctrine that the positive electricity approaches the earth according to the dryness of the atmosphere, and approaches nearest to it when the dew point continues very low, and vice versa.

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* "Who knows then, but there may be, as the ancients thought, a region of this fire above our atmosphere, prevented by our air, and its own too great distance for attraction, from joining our earth."—*Franklin's letter to Cadwallader Colden, April 23d*, 1752.

† "I believe myself justified in the inferences, that not only the space occupied by the globe, but the region beyond our atmosphere, or where the air is sufficiently rare to act as a conductor, must abound with electricity."—*Prof. Hare's paper on Tornadoes, Aurora, &c.*

It is well known that when a body charged with positive electricity, approximates another negatively electrified, having a bad conductor between them, the positive electricity has a tendency to whiz off.* These facts being admitted it follows that when one body, (as the air,) being charged with positive electricity, approaches another, (as the earth,) negatively electrified, the positive electricity will whiz off and produce in the dark, those beautiful diffused and continued flashes known as the aurora borealis.†

The magnetic needle is deranged in proportion to the brightness of the aurora, which is another proof that the proximity of the positive electricity to the surface of the earth is the cause of the aurora borealis and australis.

If the higher strata of the air are at all times charged with the electric fluid in an opposite state to that of the earth there must exist a great excitement between them; for if a small glass tube be rubbed it will cause pieces of paper to stand on end. Now if so small a quantity of electric fluid will produce so great an excitement, what must be the effect of the immense body of electrified air on the living objects on the surface of the earth? May not animal and vegetable life depend upon that excitement, and if it does, would not an increase or diminution of that excitement as the fluid approached or receded from the surface of the earth, depress, or stimulate the vital action and cause disease? May not epidemics be produced in this way? The traveling of epidemics could be accounted for on this principle, for when one portion of the air happens to contain more or less of the fluid than the rest, it would be distributed to, or subtracted from the other portions until all were equally electrified, and thus carry the epidemic from one country to another.

Experiments of this nature would show whether at the time of an epidemic there was a difference in the height of the lower surface of the positive fluid, and what height was necessary to produce it. They would also show if comets, volcanic eruptions, &c. affect the electric state of the air.

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* The electric brush, for example, produced from a point suspended above a conducting surface, is an aurora on a small scale; the rays of light are only seen above, where the fluid is given off.

† "The aurora may arise from discharges from one ocean of electricity to the other, which, not being concentrated by its attraction for intervening clouds within air sufficiently dense to act as an electric, assumes the diffuse form which characterizes that phenomenon."—*Prof. Hare's paper on the Water Spout, Aurora, &c.*

ART. X.—*Experiments upon the Induction of Metallic Coils;* by JOHN B. ZABRISKIE, M. D. of Flatbush, L. I.

Prof. HENRY of Nassau Hall, Princeton, made the important discovery, that if an electric current be passed through a long coil of wire or metallic ribbon, the electricity was much increased in intensity.* This effect of a coil, although at first it may appear merely as a very curious fact, yet is a discovery of great importance, especially in administering galvanism to animals, and in the construction of galvanic and electro-magnetic apparatus. The intervention of a coil converts a calorimotor into a deflagrator, giving it the power of burning metals, decomposing fluids, giving shocks to animals, &c.

In using galvanism for medical purposes, the coil is very convenient. It may be transported without any difficulty, and a simple galvanic arrangement consisting of a small plate of copper and zinc each, is sufficient to charge a large coil. The effect of the coil upon the system is different from that of an electrical machine or Leyden phial; it does not give a shock, but produces a spasm of the muscles, and if the circuit be repeatedly broken, or what is still more powerful, if this circuit be constantly reversed by means of the bascule of Ampere, a constant succession of spasms is felt, which, with a coil of any size becomes insupportable. On this account the coil is more especially indicated in rheumatism, palsy, and diseases of a similar nature, while the electricity of the Leyden jar is more powerful as a stimulant to produce absorption. But in the construction of galvanic apparatus, and in making electro-magnetic experiments, the coils of metallic ribbon are very valuable both in diminishing the expense of the instruments, and lessening the labor of the experiments, while the convenience of their application is much greater than that of a number of wires, allowing a ready alteration in the arrangement of the experiment, and of an easy mode of increasing the power of the apparatus merely by increasing the length of the coils.

Galvanometers may be constructed upon this principle by surrounding the needle with a coil of metallic ribbon. An instrument constructed in this manner has been used by the author for a long time, and is found to be quite as sensible as the ordinary galvanoscope to small galvanic currents, and much more powerful when the current is large. It consists of a needle suspended upon a pivot, encompassed with a coil of zinc ribbon one half an inch wide and twelve feet long, covered with silk. The most delicate instruments are those constructed upon the principle described by Mr. Locke in the thirteenth volume of this Journal, in which a small wire is wound round a disk, so that the needle may be near the electrical current at every angle of deviation, and the needle is suspended by a silk thread. But all instruments of this size are galvanoscopes, merely indicating the presence of a small current, without giving us the power of comparing with each other the force of two currents, as exhibited in different experiments. For this purpose a large instrument constructed upon the plan mentioned above will be found very useful and correct. I have used a galvanometer composed of a needle two feet long, suspended upon a pivot, and surrounded by a coil of zinc ribbon covered with silk. This instrument will be found to be much more powerfully affected than those constructed with a coil of wire, and many very interesting and useful experiments may be made with it.

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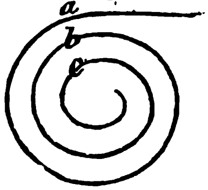
* See the American Journal of Science, for July, 1832.

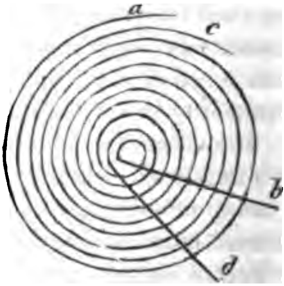
The effect of a coil of metallic ribbon has never been satisfactorily explained. Analogy would lead us to suppose that a current passing through a conductor in one direction would give rise to a current in an opposite direction, in an adjacent wire, from the known effects of electric and magnetic induction. But this appears not to be the fact, as two currents running in the same direction, increase the effect of each other, by being brought nearly together. Thus in the coil *a b c* (fig. 1.) the current passes in the same direction through the adjoining layers *a*, *b*, *c*, and the effect of the current in *a*, upon the current in *b*, instead of retarding its motion and diminishing its effect will be greatly to increase its intensity. And as every successive layer of the coil will produce the same effect, they all conspire to increase this intensity. That the effect of the coil is not entirely owing to induction of any kind, is proved by the experiment that a current from a calorimotor passed through a long wire or metallic ribbon, gives a spark, even when the greatest care is taken to prevent any portions of the conductor from lying near each other. This spark will not be as great as when the conductor is coiled in the form of a flat spiral, but the fact of its giving a spark, while a short conductor will not give any, shews that it is partly owing to the distance which the electric fluid is obliged to travel. The following experiment also shews that the

Fig. 1.



induction of galvanic currents must be extremely small. Two ribbons of zinc well covered with silk, each eighty feet long and one inch in width, were wound together into a flat spiral, and the two extremities of one were connected with a sensible galvanoscope. Upon connecting the ends of the other with a calorimotor, containing twenty four square feet of zinc, no effect could be perceived upon the galvanoscope, while a bright spark was perceived upon breaking the connection of the other coil with the calorimotor. This experiment shews that galvanic induction must be very trifling, if after a current traverses a conductor eighty feet long, it would produce no effect perceptible by a galvanoscope in another conductor of the same length, wound into the same coil. Let *a*, *b*, (fig. 2.) represent the extremities of one coil, and *c*, *d*, the extremities of another, both of which are coiled into one flat spiral. If the extremities, *a*, *b*, be connected with a sensible galvanoscope, upon connecting the extremities *c*, *d*, with a powerful calorimotor no effect will be perceptible by the galvanoscope. Again, upon connecting the inner end of one ribbon *b*, with the outer end of the other *c*, by means of a cup of mercury, and connecting the other extremities of both ribbons with a calorimotor, the fluid thus running the same way in both ribbons, a much more vivid spark is obtained by breaking the contact at the cup of mercury than when only one ribbon was used. If the outer ends of both ribbons be connected with the cup of mercury, upon passing the current through this coil which thus passes in opposite directions in the adjacent layers, no spark whatever will be perceived upon breaking the contact. These experiments therefore, appear to demonstrate, that adjacent currents running in the same direction, mutually conspire to increase the intensity of the effect, but when they run in opposite directions, they destroy it altogether. Part of the effect of a coil in increasing the intensity of the galvanic effect of a calorimotor, may be considered as owing to the length of the conductor, upon a principle not hitherto explained, and a part of its effect appears to be owing to the accumulation of the electric fluid in so small a space, whereby its repulsive power is increased, and it is enabled to overcome greater obstacles than in ordinary cases. The effect appears to be similar to that of a small

Fig. 2.



Leyden jar, which produces a more vivid spark and a sharper snap, than a large jar or a battery, in which the quantity of the fluid is increased, but its intensity diminished. The intensity of the galvanic fluid alone is increased by the coil, while its quantity remains the same, as is proved by the following experiment. A large galvanometer having a needle two feet long, was connected with a calorimotor of twenty four square feet of zinc, charged with a very weak acid. It gave a deflection to the needle of 35°. When the charge of this calorimotor with the same acid was passed through a coil of zinc ribbon two inches wide and one hundred and eighty feet long, the needle of the galvanometer still gave the same deviation of 35°. The spark at the same time was very vivid, and a shock was felt upon breaking the communication, when two handles soldered to the extremities of the coil were held in the hands. From this experiment we learn that the intensity of the electricity alone is increased by traversing a coil, and that the quantity of the fluid is not increased or diminished by passing through this circuit of one hundred and eighty feet.

The following experiments were made for the purpose of ascertaining the best method of constructing electro-dynamic magnets by means of coils of metallic ribbon.

1. A horse shoe of soft iron, twenty four inches long and one inch in diameter, was wound with a single covering of zinc ribbon covered with silk. When the extremities of the zinc were immersed in the cups of a small galvanic battery containing only eighteen square inches of zinc, a considerable degree of magnetism was induced in the iron.

2. A ribbon of zinc one inch in width and twenty four feet long, was wound around the same iron in small coils of four in thickness each, and succeeding each other the whole length of the iron. The effect in this experiment was greater than in the last, but not as great as I had reason to expect.

3. The same ribbon used in the last experiment was wound singly around the iron and then back again, covering the iron in this way with four thicknesses of the zinc, and winding in the same direction the whole time. Upon applying the battery, the induced magnetism was less than in the first experiment. As the ribbon was wound in the same direction the whole time, so the tangential direction of the revolving magnetic force in each layer of the zinc tended constantly towards the same pole of the temporary magnet—the result was unexpected. But it was doubtless owing to the oblique direction of

the covering, and which obliquity in the contiguous layers was in an opposite direction. As the ribbon was one inch in width and the iron one inch in diameter, the angle at which the layers crossed each other was more than 45°.

4. The whole horse shoe was then wound with the same ribbon singly, and that which was left after covering it was then coiled spirally upon one extremity of the iron. A strong magnetic action was now developed in the iron, much superior to that shown in any of the preceding experiments. The pole supporting the spiral coil was much superior in power to the other.

5. The iron horse shoe was then covered with one hundred and thirty feet of the same ribbon. This was wound singly over the whole iron, and a spiral coiled around each pole, the two spirals being coiled in different directions, and one containing about twenty five feet more than the other. This arrangement shewed considerable magnetic power, but not quite as much as the last. The two coils being wound in different directions, nearly neutralize each other, and the only power gained is that produced by the excess in the length of one coil over the other.

6. The same ribbon used in the last experiment, was coiled in two spirals, one around each pole of about equal size and wound in the same direction, and having the extremities of the ribbon in the center of each coil respectively. This produced the most powerful effect yet experienced, as the apparatus with the small battery of eighteen inches and very feebly charged was capable of raising fifty pounds.

7. The whole apparatus was disposed as in the last experiment, only that the extremities of the ribbon in one coil proceeded from the center, and in the other from the circumference. This produced the most powerful effect of all and with the same battery raised nearly twice the same weight.

8. If the whole apparatus be arranged as in the last experiment, and another coil be placed upon the extremities of the iron, taking care that the current run in the same direction in both coils, upon connecting this with the same battery as the other coil, the power of the magnet will be greatly increased.

It must appear evident to every one that the power of these magnets may be increased ad infinitum, by increasing the size of the horse shoe of soft iron, by increasing the width and length of the metallic ribbons, and also increasing the power of the battery. The effect may be considered as similar to that of a number of wires wound in the same direction, whose surface is equal to that of the ribbon. The labor of constructing a magnet of any size upon the old plan, by winding an iron with a number of wires, is very great, but a magnet constructed upon the plan mentioned above may be made in a few hours.

The expense of construction is also vastly diminished, and this, not only by diminishing the labor, but also the cost of materials. And as the power of the magnet may be increased to an unlimited extent, it must be preferable in every respect to those constructed with wires.

ART. XI.—*Description of the model of an Electro-Magnetic Engine, constructed by* JOHN B. ZABRISKIE, M. D.

THE facility with which the poles of an electro-dynamic magnet may be changed by reversing the electric current passing around it, first suggested the construction of electro-magnetic engines. The first apparatus constructed upon this principle was made by Prof. Henry, who gave a vibratory motion to a magnet to which were attached two bent wires alternately dipping in two cups of mercury on each side.

Some time since I constructed a model of an engine upon this principle, of which the following is a description.

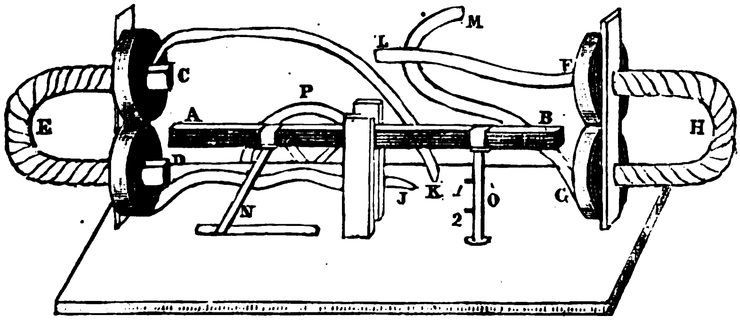
A, B, is a large compound magnet, composed of sixteen bars of steel, each one quarter of an inch in thickness and two feet long, magnetized separately, and combined into one magnet. This has an alternating motion upon an axis between the poles of two horse shoe galvanic magnets, constructed upon the principle mentioned in the preceding article.

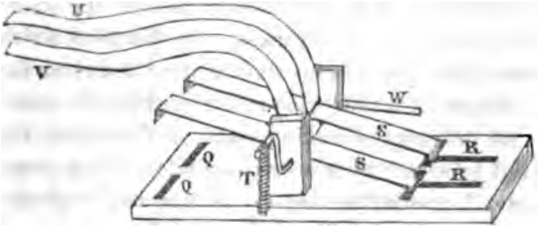
These magnets C E D, F H G, are composed each of a horse shoe of soft iron, twenty four inches long, and one inch in diameter, wound with a zinc ribbon one inch in width, and one hundred and twenty feet long.

N, is a rod turning a crank which moves the fly-wheel P. O, is a rod having two pins projecting from it which moves a lever attached to a bascule, which for the sake of distinctness is not represented in this figure but may be seen below. This is composed of a piece of mahogany pierced with four holes, two of which are oblong, and two shaped like a T. These holes are connected by pieces of copper, which form their bottom, being made into tight cups by sealing wax. These pieces of copper cross at the center, and are kept from touching each other by silk, and thus connect those holes which are diagonally opposite. S, S, are two pieces of copper which are fixed upon an axis in such a manner as to allow the extremities to dip alternately in the two pair of holes, which are filled with mercury. T, is a spring of wire, which by means of a crank fastened to the axis of the two strips of copper S, S, brings them down to the cups of mercury either way whenever the crank has passed the perpendicular. U, V, are two strips of zinc soldered to the center of S, S, and which are connected with the poles of a galvanic battery. W, is a lever fastened to the extremity of the axis, and which moves it together with the strips S, S. The extremities of the ribbons J, K, L, M, are inserted in the cups of mercury R, R, one from each magnet being inserted in each cup, and the arrangement being such that the upper poles of the temporary magnets shall both be of the same name. The lever W, is moved by the pins 1, 2, of the rod O, thus continually reversing the currents of electricity as they flow through the ribbons J K, L M, of the two galvanic magnets, and in this way changing the poles of these magnets.

Let us then suppose the end A of the magnet A B, to represent the north pole, and the pole C of the magnet C E D, also a north pole, while the arrangement is such that F is the north pole also of the magnet F H G. The ends J, K, L, M, being properly arranged in the two cups R, R, and the lever W, being placed between the pins 1, 2, of the rod O, upon connecting the zinc ribbons V, U, with the poles of a calorimotor the horse shoe magnets become instantly active, and the north pole A is repelled from the north pole C, while the south pole B is attracted towards the north pole F. The pin 2, by being raised, at length raises the lever W, and the strips S, S, are brought by the spring T to the cups Q, Q, when the currents in the zinc ribbons around the temporary magnets are instantly reversed, and the two lower poles converted into north poles. The north pole A is then instantly repelled from the north pole D, and the south pole B from the south pole F, until the pin 1 depresses the lever W, when the currents being again reversed the apparatus is in the same state as at the first. In this way a constant alternating motion is kept up. The model of this size works well, and with considerable power.

The power may be increased almost infinitely, by increasing the size of the temporary magnets, by increasing the number and the length of the bars of the permanent magnets, by increasing the width and length of the metallic ribbons surrounding the temporary magnets, and with these by increasing the power of the galvanic battery.





Art. XII.—*On Zinc Roofing;* by Prof. L. D. Gale, of the New York University.

Read before the Mechanics' Institute, June 6, 1837.

TO THE EDITOR.

Sir—The following remarks are intended as a reply to a paper by my friend Prof. Caswell, of Brown University, and which appeared in the 31st volume of this Journal. In March, 1836, I published in the Mechanics' Magazine of this city, (New York,) some remarks on zinc as a roofing material, substituted for slate, copper, tin or tiles, in which I stated the bad results that had followed the experiments made on zinc in this city, and pointed out the defects of that metal. Parts of that paper were copied into the newspapers of the day, from which I suppose Prof. C. obtained his idea of its correctness, inasmuch as he has both misconceived and misquoted my paper. In the present remarks I shall first state the positions taken in my former paper, and then proceed to give the details of my experiments, and let others who may be disposed to read the article draw their own conclusions.

Prof. Caswell commences the argument in his paper on the three following subjects, *supposed* to have been the divisions of my paper in the Mechanics' Magazine.

1. Difficulty of making the roof tight.
2. Deterioration of the water which falls from it.
3. Comparatively small resistance which it offers to the progress of fire.

My own division, however, is quite another thing: it is the following. Zinc is objectionable, (as a roofing,) First, from the great expansive power of the metal. Secondly, its brittleness. Thirdly, it deteriorates the water.

As Prof. C. has embraced my threefold division under two heads, namely, tightness of roofs and deterioration of the water, I shall make a few remarks on each of these. As his third division has no place in the original paper in question, it need absorb no time in this.

On the difficulty of making zinc roofs tight Prof. C. states, "There is no practical difficulty in making a zinc roof *perfectly tight*," and this is proved he says "by numerous certificates that place the subject beyond all reasonable doubt. A zinc roof may as easily be made tight as any other. There may be sheet zinc in the market of a bad quality, but none need be deceived on this point, since nothing is easier than to test its flexibility."

This is, it must be confessed, a pretty summary way of disposing of so important a matter. There is probably no place in the United States, where the experiment of zinc roofing has been so extensively tried as in this city. I think I can point out between seventy and one hundred buildings, to my personal knowledge, that have been covered with zinc, and in a very considerable portion of them it has been removed, and its place supplied by copper, tin, or slate; and those roofs that still remain, covered by zinc, I have ascertained by careful investigation, are more expensive to keep in repair than any other roofs whatever; and furthermore, I would say, that zinc is now almost entirely out of use in this city as a roofing material. Let me ask my friend Caswell, why most of our New York builders, as well as the proprietors of buildings, have abandoned the use of zinc, if there be *no practical difficulty* in making a zinc roof *perfectly tight?* Has Messrs. Crocker and Brother's zinc not come to the New York market? Has not "foreign zinc from the best manufactories" been imported and tried in this city? Yet all this avails nothing. So long as zinc retains the name and properties of zinc, it will continue to be a brittle metal, and though by heating it to a certain point, it may be rolled into thin flexible sheets, yet, after a few years, the metal becomes nearly as brittle as it was before being wrought. This fact is a prominent one, not confined to zinc only, but is common to most other metals; thus, malleable iron laid by for many years, becomes exceedingly brittle, from a tendency in the metal to assume the crystalline texture. I have observed fragments of sheet zinc laid by for a number of years, become so brittle that they would scarcely admit of bending without fracture. This seems to be a general principle, and I have little doubt that it forms one of the great difficulties in keeping zinc roofs in repair. Now if Prof. Caswell and Messrs. Crocker, Brother & Co. have discovered that there is no difficulty in making zinc roofs *perfectly tight*, and that their zinc "will bear to be doubled and hammered down without any appearance of fracture in the bend," and that the same remark is true of their zinc generally, I would advise them to come to New York and teach our builders how to make zinc roofs *tight;* for our workmen are unable to do it, and consequently zinc has almost entirely gone out of use for such purposes in this city.

I did observe in my paper, that water drained from a zinc roof is deteriorated, and thus is injured, either for washing or for culinary operations. Now because the same properties are not noticed by Thomson, Berzelius, Brande or Turner, Prof. Caswell has very judiciously come to the conclusion, that such properties as I have attributed to zinc cannot exist; therefore, I must have been mistaken. He also says I have not stated very fully the reasons on which my opinion was founded, with regard to the oxidation of zinc on roofs and the solubility of the oxide so formed, and as a proof that I was mistaken he has exposed water from a zinc roof to the air in clean glass vessels for several days, without any appearance of a precipitate: he has also kept the water for several days in a vessel of oxygen gas, subjected to frequent agitation, without precipitation or appearance of milkiness. Hence, he says, "if such water contains the suboxide of zinc, its presence is not to be detected in this way." The conclusion from the above experiment is, I think, very just, but we shall see whether it will apply equally to my experiments, which I shall now give in detail. They were made with a zinc roof, one hundred and eighty feet by ninety, equal to sixteen thousand two hundred square feet, and repeated for three months, at every shower of rain, and the effects produced by alternate dryness and moisture upon the metal were carefully noted. I cannot go into great minuteness of detail, but only sufficient to show the method of experimenting and the result.

As soon as a shower of rain began to fall on the roof, some of the first water that ran was collected and found to have a strong metallic taste, and to decompose soap. The water was set aside and allowed to remain at rest for some weeks, when a fine light yellowish sediment was found on the bottom. This effect was remarkably evident in the cistern, where the metal was precipitated from a large body of water. The sediment was carefully examined, and found to be oxide of zinc. In many cases no sediment was obtained from water that was examined, though collected in the early stages of a rain; so that no good results could be expected from a single experiment. The greatest amount of sediment was produced from a fall of snow, allowed to remain on the roof until removed by gradual thawing. The water drained from the roof under such circumstances was highly charged with metallic matter, which at length disappeared, and a sediment of oxide of zinc was found on the bottom of the vessel and the water left quite pure. Now as a metallic compound did exist in the water, and as that, at length, disappeared by exposure, and oxide of zinc was found deposited on the bottom of the vessel, I inferred that the soluble compound was a suboxide of zinc, and probably the one described by Berzelius. Since Prof. Caswell's paper has appeared, I have called on a number of builders and workers in metal, to ascertain whether and how far my experiments and opinion, expressed in my paper in the Mechanics' Magazine, coincided with facts as they occur to the workmen, and I am happy to say that I have nothing to retract. The following corroboratory remarks are from the Albany Daily Advertiser.

"ZINC.—The experience of two winters has proved to our satisfaction, that this is a worthless material for covering the roofs of houses. It very soon becomes rotten, and, as it is put on, affords very little protection against rain or snow. Tin or slate will be found far preferable."

In conclusion, I will again say, if zinc is a valuable material for roofs, which can easily be made tight, why is it that the article is going out of use as fast as possible? Why is it that no new zinc roofs are furnished in this great metropolis? It may be said, that they have used a bad article. But, I repeat, does not Crocker & Brother's zinc, does not the best foreign article, come to the New York market? Where have purchasers a better opportunity of selecting good zinc, where have builders a better opportunity of experimenting and ascertaining the best material for roofing? Is it probable that men who have gone deeply into the business of roofing with zinc, would readily abandon it, if they could sustain it? Would proprietors sustain the expense of tearing off the zinc and substituting some other material, if there were any other better method of managing? Would they not first resort to the expedient of mending? This last question I can answer from personal knowledge, that mending of zinc roofs has in some cases been nearly equal in expense to half the first cost. I am quite satisfied, that if my friend, Prof. Caswell, will review the whole matter of zinc roofs, he will come to the conclusion that notwithstanding the superior products of Messrs. Crocker, Brother & Co. there are still difficulties in the use of zinc as a roofing material that are not entirely imaginary.

Art. XIII.—*On the Common Blowpipe;*[*] by J. W. Bailey, Acting Prof. Chem. &c. U. S. Mil. Acad., West Point.

On account of its portability, the facility of its use, and its numerous applications, the blowpipe ranks as one of the most valuable instruments of chemical research. It consists essentially of a tube, generally bent and having a small orifice, by means of which a current of air, from the lungs, may be forced through the flame of a lamp or candle.

Fig. 1.

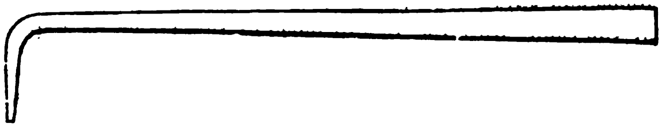


Fig. 1, shows the simplest form of the blowpipe, and such ones are easily made from glass tube in case of necessity, but they are inconvenient when made of this material on account of their easy fusibility.

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[*] These notes were drawn up to form part of the course of chemistry at West Point, and being solely intended as an *introduction* to the use of the blowpipe, were purposely made as elementary as possible—but it is supposed the directions may be useful to other students.—Ed.

Even a piece of the stem of a tobacco pipe can be used as a blowpipe when no better means are at hand.

In experiments requiring a long continued blast, the moisture of the breath condenses in the tube in such quantities as to be inconvenient, and the best blowpipes are provided with a small chamber to collect this moisture, and prevent its being forced out at the orifice into the flame.

Fig. 2.

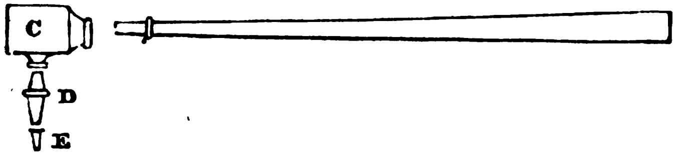

Fig. 2, shows the parts of a blowpipe provided with a chamber C. At D is a conical orifice which slips into the projection from the chamber. At E is a small perforated cone, to be placed *over* the end of D when a smaller orifice is required.

Fig. 3.

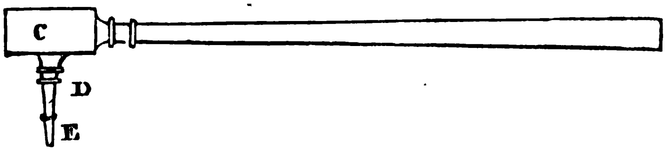

Fig. 3 shows the blowpipe arranged for use.

In using the blowpipe it is highly important to be able to keep up a well regulated and long continued blast. The power to do this can be acquired only by practice, but the following directions, taken from Shepard's Mineralogy, will facilitate the acquisition. "Closing the mouth, keep the cheeks distended with air, during a number of inspirations and expirations performed through the nostrils. Next attempt the same with the mouth-piece of the blowpipe between the lips: now as this provides an exit for the air in the mouth, the cheeks will soon collapse; to prevent this at the moment of expiration through the nose, a sufficient quantity of air must be allowed to enter the mouth to preserve their distention. By this means the air in the mouth is constantly subject to the same compression and flows in a uniform manner from the little orifice. Having acquired the habit of keeping up a continued current of air from the blowpipe, the beak is now brought within the border of the flame of a lamp or candle. We immediately perceive before the orifice a long and conical blue flame environed by an outer cone more resembling the common flame of a candle. It is at the apex of the blue cone that the most intense heat is produced."

"*Oxidation* takes place when we bring the matter of assay before the apex of the *exterior flame*, where the combustible matter coming from the candle has ceased to attract oxygen. The heat required for this is only that of incipient redness; and one of the larger orifices is best for producing this temperature.

"Reduction requires a more elevated temperature, which is best obtained by one of the finest orifices, which should be introduced only within the edge of the flame. A less distinctly blue cone than in the former instance, surrounded by a more brilliant one will be the result. The matter to be deoxidized is to be supported completely within the bright flame just beyond the apex of the blue cone: in this part there is inflammable gas which, of course will take oxygen from the substance to be reduced."

The size of the mass to be heated, including the flux when one is used, should not exceed that of a pepper corn, and when the substance is to be heated alone, the piece should not be much larger than a pin's head.

To support the trial piece, various substances are used; such as charcoal, platinum wire or foil, small cones of clay, or in fact any substance which is infusible and a bad conductor of heat.

Charcoal is an excellent support in reducing operations, and whenever its actions will not *interfere* with the result desired. The best charcoal for supports is made from light porous wood such as pine, and it is important that it should be recently burned.

Platinum on account of its infusiblility and low conducting power for heat, is the best metallic support that can be used; and when slips of the wire or foil are inserted in glass handles they are very convenient, particularly when the action of fluxes is to be examined. The handles are easily made by drawing a quill tube to the proper size and then placing in one end of it the bit of platinum sealing it in its place by directing upon the glass, a flame, by means of a blowpipe.

When the platinum supports are used with fluxes, a little of the flux in powder is to be taken up on the extremity of the platinum which is slightly moistened to cause it to adhere; then introduce it into the flame and fuse it, and *while fused* touch it to the trial piece, or, which is more convenient, allow it to cool, then moisten it and touch it to the substance which will immediately adhere. If the same supports are to be used without fluxes then the trial piece may easily be attached by a little adhesive clay, moistened.

Pieces of glass tubes, about the diameter of a quill, and three or four inches long, are often used with the blowpipe; and are distinguished by the names "*open tube*" or "matrass," according as the tubes are open at *both* ends, or only one. They are often used to roast substances; or to expel from them some volatile substance which may either condense on the cool part of the tube, or else by its odor or some other characteristic property, be easily recognized.

In tube experiments the spirit lamp is generally used; for the reason that although it gives less heat than the oil lamp or candle, it possesses the advantage of not soiling the exterior of the tube.

The fluxes generally used with the blowpipe are *carbonate of soda*, *biborate of soda*, and the *double phosphate of soda and ammonia;* which for brevity are called "*soda,*" "*borax,*" and "*salt of phosphorus.*" The last is also called microcosmic salt.

Black flux may also be used advantageously in certain cases, but a mixture of pounded charcoal with "soda" will supply its place.

Soda or carbonate of soda, by uniting with silica aids the fusion of refractory substances, and facilitates the reduction of metallic oxides. It also, on account of the affinity of sodium for sulphur, arsenic, &c. often acts to reduce sulphurets, &c. to the metallic state.

Borax.—This substance also assists fusion on account of the property it possesses of forming fusible salts with many substances which themselves are infusible. By the color of the glass produced, the nature of the metal or metallic oxide is known.

Salt of phosphorus.—When the substance is heated it loses its ammonia and is changed into a metaphosphate of soda, which unites with bases and forms fusible salts, liberating the acids with which the bases were combined. The characteristic colors of metallic substances are shown better with this substance than with borax.

The following table, from Necker's "Règne Mineral" shows the colors which various metals give with the three fluxes, when heated either in the oxidizing or reducing flame; and also shows the difference, if any, between the color of the glass when hot and when cold.

N. B. The letter H signifies hot glass,—C the *cold* glass.

Reaction of the Principal Metallic Oxides, with the three Fluxes, by the Blowpipe.

Oxides of	SODA.	BORAX.		SALT OF PHOSPHORUS.	
		Oxidizing flame.	*Reducing flame.*	*Oxidizing flame.*	*Reducing flame.*
Chromium.	H. Orange. C. Yellow. In reducing flame. Green.	H. Yellowish brown. C. Colorless or slightly green.	H. Emerald green. C. Colorless.	H. & C. Green.	H. & C. Green.
Antimony.	H. Colorless. C. White.	H. Yellow. C. Nearly colorless.	H. & C. Opaque, grayish.	Colorless.	Colorless.
Titanium.	H. Dark yellow. C. White or grayish.	H. Colorless. C. Opaque white.	H. Yellow. C. Violet amethyst or blue.	Colorless.	H. Yellow. C. Beautiful violet.
Manganese.	H. Transparent green. C. Bluish green.	Amethyst.	Colorless if suddenly cooled.	Amethyst.	Colorless.
Cobalt.	H. Red. C. Gray.	Blue.	Blue.	Blue.	Blue.
Nickel.	Insoluble in the flux.	H. Orange or reddish. C. Yellowish or colorless.	Opaque, grayish.	H. Orange or reddish. C. Colorless.	H. Orange or reddish. C. Colorless.
Iron.	Insoluble in the flux.	H. Dark red. C. Yellowish or colorless.	Bottle green.	H. Dark red. C. Colorless.	Bottle green.
Zinc.	Insoluble in the flux.	H. Colorless, transparent. C. White, opaque.	Sublimes, & deposits a white powder on the charcoal.	Same actions as with borax.	
Lead.	H. Colorless, transparent. C. Yellowish, opaque.	H. Yellow. C. Colorless.	Partly reduces.	Colorless.	Does not reduce, colorless.
Copper.	H. Green, transparent. C. Colorless, opaque.	Green.	H. Colorless. C. Cinnabar red.	Green.	H. Colorless. C. Cinnabar red.

The mode of recognizing various other substances in minerals, by means of the blowpipe is given below.

If a mineral containing water be heated in a matrass, the water will be expelled, and condensing upon the cool part of the tube will appear like dew. If the water was chemically combined, some striking change in the appearance of the mineral will generally be observed, such as loss of transparency, change of color, &c.

When sulphurets of the common metals, are heated in the open tube, the odor of sulphurous acid will be perceived at the upper orifice; and a slip of paper stained with decoction of Brazil wood, if placed in the tube, will be turned yellow or bleached.

If sulphates are melted with a glass of *silica and soda*, a sulphuret of sodium is formed which communicates to the glass a *characteristic brown color*, like that of liver of sulphur.

Chlorides melted with a mixture of *salt of phosphorus* and *black oxide of copper color* the *flame, blue or green.*

If *fluorides* are heated with *salt of phosphorus,* in the open tube, *hydrofluoric acid* escapes, which *corrodes the glass* and turns Brazil paper yellow.

If *phosphates* are melted, by a good fire of reduction, on charcoal, with *boracic acid,* and a small piece of *iron wire* is plunged into the globule, it is *partly oxidized* at the expense of the phosphoric acid, and dissolved; while the *remainder forms* a *phosphuret* of *iron,* which by breaking the globule, will be found as a more or less brittle mass. If phosphoric acid were not present, the iron wire will be found unaltered.

If *nitrates* are heated in the matrass, with a drop of *sulphuric acid,* they are decomposed with evolution of nitrous acid fumes, which may be recognized by the color, and by *turning* to *black,* small scales of the *cyanohydrargyrate* of *iodide* of *potassium* previously placed on a dry part of the tube.

If *boracic acid,* or the *borates* are melted with *Turner's reagent* (a mixture of one part of fluoride of calcium and four and a half of bisulphate of potassa) a brilliant *green color* will be given *to the flame.*

Ammoniacal compounds when heated in the open tube with *fixed alkaline bodies,* (as lime or potassa) *give off ammonia* which will be recognized by its odor, &c.

Potassa gives to the brown glass of borax and oxide of nickel a blue color which soda will not.

The *salts of soda* color flame, a rich yellow.

Lithia attacks platinum foil and leaves a dull yellowish trace; and minerals containing it, give at the *moment* of fusion (especially if mixed with fluor spar) a red tint to the flame.

Most of the *salts of strontia* impart to flame a fine red color.

Many *salts of lime* give to flame a brownish red color.

Substances containing much alumina, when moistened with *nitrate of cobalt* and heated, assume a *beautiful blue color.*

Magnesia gives with nitrate of cobalt a pale rose color.

When substances contain much *silica* they will, when *fused with salt of phosphorus,* form a spongy mass or *skeleton* in the *middle of the globule* of glass; but if the silica is in small quantity its infusible particles in place of forming a skeleton, remain diffused through the glass and impair its transparency, giving it an opaline appearance.

Arsenical compounds heated alone on charcoal, or in the open tube with *black flux* give the *odor of garlic.*

Antimonial compounds may be recognized when heated in the open tube, by giving white fumes which are easily driven by heat from one part of the tube to the other, and have not the odor of garlic.

The *compounds of mercury* heated in the matrass with lime or iron filings, yield metallic mercury which sublimes.

The principal ores of *lead and silver* are easily reduced on charcoal alone, and with still more ease, with a little soda.

This list might be much extended, and other characters might be mentioned for many of the substances; but it is believed best to give only those which are most important, and easily remembered.

By applying the principles of chemistry, many other processes will suggest themselves to the intelligent student and as Bergman remarks "celui qui apporte dans ce genre d'experiences une main habile, se fraye tous les jours, de nouvelles routes qui conduisent toutes a la verite."

Art. XIV.—*Notice of the Gold Veins of the United States' Mine near Fredericksburg, Va.*; by Lt. M. F. Maury, U. S. Navy.

TO THE EDITOR.

Dear Sir—A mutual friend informs me that you have mislaid, or lost, your notes on some of the gold mines in this vicinity; he has requested that I would supply the deficiency; this I cannot pretend to; but as I was with you when you visited the United States' gold mine last summer, I may be able to embody some facts and circumstances, which will bring to your memory the striking features of the lost notes.

If you recollect there are several veins at this mine, which *strike* and *dip*, each in a different direction; the former (the *strike*,) is tortuous, and the angle of the latter is not constant.

The general course of vein No. 1. is about N. E. and S. W., it passes through a micaceous slate, which, near the surface, is soft and fissile, being easily removed with the pick; but at the depth of one hundred and twenty feet, it loses its fissility, and passes into a hornblende (?) slate, which is very compact and is with much difficulty removed by blasting.

Near the surface, the vein dips to the west at an angle of 54° with the plain of the horizon; but as it gains in depth, it curves, gradually approaching a perpendicular, until at the hundred and twenty foot level, (the lowest point at which it has been cut,) where it makes an angle of 20° with a perpendicular.

The vein conforms with the stratification of the slate, the *smooths*, or faces of which, sometimes form, for many feet, regular and beautiful walls to the vein, which walls are as smooth as though they had been chiseled; and were it not for their inclination, the *sides* of the tunnel at such places might be likened to the black walls of a large and narrow dungeon.

The matrix of the vein is quartz, cellular and laminated; the joints or faces of the laminæ being thinly coated with the capel (?) (decomposed shale,) of the lode, and sprinkled with argentiferous galena, blende, (the *black jack* of miners,) and sulphuret of iron; frequently spangles of gold may be seen lodged in the slate, when the quartz is just from the mine, or is freshly cleft. It is difficult to preserve such specimens, for when exposed to the air, whether in the pile, or in the cabinet, the shale already disintegrated and nearly in the form of clay, becomes dry and loses its consistency, when the gold, having nothing to support it, falls off. In juxtaposition to the pyrites, irregular crystals of the ferruginous sulphuret of copper are occasionally seen, which from their peculiar yellowish hue, are often taken for gold. Some specimens on their faces of cleavage are studded with perfect and beautiful crystals of the phosphate of lead; these surfaces are frequently variegated with tints of black, brown, purple and yellow; and the green acicular prisms grouped in circles, lines and broken curves, present the appearance of crescents, flowers, etc. raised on the quartz in fancifully embossed work of green moss. The molybdiate and venidiate of lead are also found in this vein.

The thicknes of the vein is variable; at some places it is near three feet, at others it thins out into a mere *thread* or seam, then widens again. After being cut by a *cross-course* of pure white quartz, it thinned out, and entirely disappeared for a few feet. Here its course was marked by a black seam between the walls; after driving a few feet on this seam, the vein was found replacing it.

At the time when the fissure which contains this vein, was formed, causes existed, to prevent regularity in the angle of inclination, as well as in the course of the vein. At one place in the eighty foot level the vein deflects from its course, forms almost a semicircle, and again comes into its former line of bearing. Above this deflection, the course of the vein in the forty foot level is continuous and there does not appear to have been any interruption in its angle of inclination, or in its line of bearing.

The other veins have an average thickness greater than that of No. 1. They are walled up near the surface in red clay, a perpendicular escarpment of which shows a succession of black lines or seams, in the regular order of stratification. Suppose a bed of gneiss to be converted, without undergoing the process of disintegration, into a mass of clay, or red earth, and that the lines showing the stratification of the gneiss were to assume a blackish hue, and be retained in the clay, and you would have a formation similar to that of which I am now writing. Disseminated through this clay, are numerous *untriturated* and angular fragments of translucent quartz, the largest of them attaining to the weight of only a few grains.

Veins Nos. 2. and 3. are parallel or nearly so; their general course is N. by E; they dip to the east. No. 2. at an angle of 30° with a perpendicular. No. 3. is nearly perpendicular from the surface to the depth of twenty five or thirty feet; while at the depth of sixty feet it has a very great *underlay*, declining from a perpendicular at an angle of near 60°.

The two veins are about one hundred feet apart; The *country* between them at the depth of sixty feet, is very soft, not being firmer than quicksands. The angle of inclination of No. 2. is quite uniform. At the sixty foot level, instead of red clay, the veins are contained in decomposed gneiss, which retains its color and texture, but is quite friable, yielding as readily as the clay, to the pick. A shaft has been sunk perpendicularly on No. 3. vein to the depth of twenty five or thirty feet; in this the vein declines from a perpendicular at a very small angle, say 5°; immediately under this shaft, in the sixty foot level, the vein inclines at an angle of 45°. I shall not offer at this time any conjecture as to this anomaly in the dip of veins. When the ore between the sixty foot level and the surface, is taken down, this very great underlay will doubtless be found to commence at, or near, the junction of the gneiss with the superincumbent clay. Circumstances which will throw more light on the subject may be then brought to view. Could it have been that the *soft country*, or quick sands alluded to, were not sufficiently firm and compact to support the vein in its nearly perpendicular position, and that for the want of proper support, it has fallen down as it were? Veins usually underlay more near the surface where the ground is less firm, than they do in depth, where they pass through rocks and a harder country; such is the case with No. 1. vein, and it is conformable with the laws which veins in their dip usually follow. In miners' phrase the country between the depths of forty five and sixty feet and about these veins, has been much *confused*. No. 2. vein has a *heave* of about five feet to the west. Here there are countless threads of the vein, some a foot, others a yard, and others a fathom or more in length, and an inch in thickness, laying horizontal and *across* the course of the vein, as if this had been suddenly broken asunder and violently thrown one side, leaving fragments strewed along its track. Threads of similar quartz frequently accompany the vein, but instead of laying horizontally and across its course, they diverge from it, run parallel to it with nearly the same inclination and finally come into the vein again.

Opposite to this heave, I expected to find a corresponding, or the marks of a corresponding heave in No. 3. vein. But instead of that, the country was more firm, the stratification of the gneiss was undisturbed, the vein thinned out and entirely disappeared; it was replaced by *killas* which marked its course for more than forty feet, when the vein again formed, being much richer here than it was where it disappeared.

The quartz from each of these veins has very much the same appearance and the same accompanying minerals. With a slight blow on its vertical edge, its tendency is to cleave readily into rhomboidal plates, but the cross cleavage not being perfect it divides into irregular oblong plates, the faces of which are mottled with the black oxide of manganese under the dentritic form, many of them presenting, with a little aid from fancy, beautiful landscape views in miniature.

Most of this quartz is translucent; it fractures with almost a milky whiteness. In some specimens the gold may be seen *within* the gangue, relieving its whiteness with delicate orange colored spots. Here the sulphuret of iron is more rare, blende and galena are seldom seen, while pyritous copper and malachite are more abundant; spots of black tourmaline are occasionally seen; and the iron pyrites assume a reticulated appearance.

Vein No. 4 lies W. N. W. and E. S. E. and dips to the north. It is between four and five feet thick. The quartz is similar in its tabular structure to that from veins No. 2 and 3; but the associated minerals of those veins, excepting the iron, are wanting here. The cubes of sulphuret of iron, in the middle of compact (externally) masses of gangue, have slowly yielded to the action of a destroying cause; their materials have gradually assumed a gaseous or more subtile form, and by permeation, or some other mysterious process, they have passed off, leaving a stain of iron upon the quartz, and oftentimes a spangle of gold glittering in the cubical cell which the pyritous crystal formerly filled: sometimes the interior of the rock is completely honeycombed by these empty cells. This vein has not been extensively explored. It dips at an angle of 45°, and like Nos. 2 and 3 is found passing through a stratified red earth, that contains numerous angular fragments of translucent quartz. The sulphate of baryta is one of the associated minerals of vein No. 1.

These veins, striking on different courses, and dipping at various angles and in different directions, cross each other at several points, forming thereby a sort of *veinous net-work* over the company's lands. Such is the character of *retiform deposits*, whether the veins be true, or contemporaneous veins. And such is the tendency of the veins at several other mines which I have visited. The establishment of the fact, whether or not the gold region be a *retiform deposit*, would be an important point gained in the economy of gold mining in this country. This is a task which belongs to others, and to them I shall leave it.

Parallel to the "gold belt" of Virginia, and running along its eastern borders, is a deposit of iron ore, which is not second to the gold region, either in value or importance. The ore is a *brown hematite*, of superior quality. It yields an excellent gray iron. Previous to the Revolution, several furnaces were supplied from it, but almost the only record which we have of their existence is found in their ruins; the piles of scoria, the extensive forests of second growth, numerous excavations, and mounds of earth, are the only monuments which tell of their former operations and prosperity. The beds were mined in a very loose way, and the ore extracted does not obviously lessen its abundance. The deposit passes with the gold belt out of the state, and perhaps continues with it throughout its range.

It is not improbable, that upon examination, the geological position of the coarser but more useful metal, with regard to the more precious, will be found useful in an economical point of view. The field of my observations is a small one, but I do not know of any mine of "vein gold" to the east of the iron range. There are several alluvial deposits of gold to the eastward of it; they are known under the name of *deposit* or *surface* mines; they are worked with profit. The gold has probably been brought to them, by the agency of water, from veins to the westward of and above the iron belt. It would be a striking feature in the geology of the state, should deposits of the two most extensively distributed metals in nature, be found in juxtaposition to each other, for many miles, each marking the limits of the other, without ever encroaching upon its borders.

ART. XV.—*Chronometers.*

HAVING in Vol. xxix, at p. 279 of this Journal given publicity to the experience of those eminent chronometer makers, Messrs. Parkinson & Frodsham, of London, we now readily extend the same courtesy to Messrs. Arnold & Dent,* of that city; aware also that, after Great Britain, no country has so deep an interest in chronometers as this, for every sea is whitened by our canvass.

The following passage from Obed Macy's History of Nantucket describes the case of many thousands of our countrymen.

"The wide ocean is the source of their livelihood, and they breast its waves and grapple with its monsters, in every latitude between the polar ices. The sun never sets on their industry; they labor and worship under the whole dome of the firmament. The objects of their affections are abroad on the deep, or buried forever beneath its billows; their prayers are wafted on every wind and their tears are mingled with every surge."

To these adventurous labors of the intrepid whalemen, the chronometer is indispensable, for the longitude, and it is said that New Bedford, the neighbor and friendly rival of Nantucket, has the time keepers at this moment to the amount of $87,000.

On the Application of Glass, as a substitute for Metal Balance Springs in Chronometers.

[From the Nautical Magazine, for December, 1836.]

Sir,—On several occasions we have occupied a space in your valuable journal with some account of experiments which we have made, with the view to introduce glass into the manufacture of chronometers, as a substitute for steel and brass in the balance and balance-springs of those machines. After a trial of more than three years, conducted at the Royal Observatory by the direction of the Lords Commissioners of the Admiralty, with two chronometers of this new construction, we have requested that they may be returned to us for further improvement. Thus the first public trial of the glass spring and its balance may be considered as closed; and with your permission, we will here briefly advert to some of the progressive experiments with it, which have been detailed in former numbers of your work, beginning with a short statement of the first application of a balance-spring to a watch.

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* Note from Messrs. Arnold & Dent, dated London Dec. 8, 1836.—Messrs. Arnold & Dent beg to present Prof. Silliman with an account of their experiments on metal and glass balance springs of chronometers, and also the official rates of two chronometers having glass balance springs and balances, *tried* by order of the Lords Commissioners of the Admiralty.

About the year 1660, Hooke first applied a spring to the balance of a watch, so that the vibrations were returned. It also admitted of the watch being regulated, and it remains *the same* at the present time in watches, as when he first applied it. Its form is that of a flat spiral, and made of steel. The effect of heat on this spring will be seen in one of the following tables, which for 68° of Fahrenheit, amounts to 385 seconds in 24 hours. To reduce this quantity, our present experiment with glass *is the first* that has been made.

While at the temperature of 68°, the error from a steel balance and spring is 385 seconds in 24 hours; that of glass is only 40 sec. It is also clearly desirable to introduce a balance-spring the elasticity of which is not produced by any chemical or mechanical process, and which is free from magnetic influence, and capable of resisting the effects of corrosion. By its adoption, the principle of the chronometer is altogether changed; and it is remarkable, that while the improvements of the mechanism in a chronometer have been many and various, the present is the *only* attempt to reduce the errors of the balance-spring, or, in other words, to reconstruct the chronometrical part of the machine *de novo*, and however chimerical the introduction of glass appeared in the first instance, it will be seen that we have made considerable advancement in the three years' trial. In that period it has undergone the most severe test from the discharge of guns on board ship, it has also been continually going for upwards of three years without fracture, and, we may add, has been of great service to Captain Hewett in his survey of the North Sea. This officer states, in a private letter accompanying his official report on it, "that the daily rates derived from the comparison with his standard chronometer, perhaps never were excelled in chronometrical journal."

The obstacle which seemed to present itself to the use of glass in the chronometer was its extreme fragility; this however, proved to be no obstacle, and having prepared a glass balance spring, we took a previously adjusted chronometer, having a hardened and tempered balance spring of steel, and having registered its arc of vibration, which was 180°, from the point of rest, we removed this spring, and applied one of glass. The vibrations were immediately increased to an arc of 200°, thus proving that glass had greater elastic force than steel, for the weight of the balance was not disturbed by the application of the glass spring, and the arc of vibration being increased and the same time preserved, its strength was necessarily equal to the original one.

Satisfied thus far with our efforts, we took it to Captain Beaufort, the hydrographer to the Admiralty, who promised us his assistance in obtaining their lordships' order for any trial to which we might wish the experiment to be subjected in our progress. Thus encouraged, the necessary adjustments for temperature, &c. were commenced.

Two important questions suggested themselves at this early stage of the experiment. The first was to ascertain how far a low temperature would affect the fragility of the glass spring; and the second was to prove by experiment whether it would withstand the shock arising from the discharge of cannon.

To determine the first question, we placed the chronometer in a temperature of 12° Fahrenheit. In speaking of this low temperature, it may not be considered as digressing too much to explain the manner in which it was obtained; and we may be allowed this opportunity of describing our method of procuring a low temperature even during the summer months. The chronometer submitted to the process is placed in a metal vessel, having a piece of glass in the top, to allow a thermometer in it to be read, and the chronometer to be compared. This vessel, which we may call the internal one, is placed in an outer one similarly constructed with a glass top, but having a space completely parted off within it at the distance of an inch and a half from its outer sides. The distance thus left being occupied by common air, prevents the exterior atmosphere from readily acting on the ice which is to be contained within the partition. The inner vessel containing the chronometer is then placed in the centre of this outer vessel, and kept in its place by blocks of wood, and the space between it and the partition above-mentioned is filled with ice and salt mixed together. The whole is then placed in an outer wooden vessel, which is subsequently incased in flannels. By this arrangement a low temperature may be preserved for many hours. The chronometer with the glass balance spring was placed in a vessel of this description, and the thermometer soon fell to 12° of Fahrenheit, at which it continued, with little variation, during the first twelve hours; at the end of twenty-four hours the thermometer was at 28°. The result of this experiment we considered satisfactory as to the power of the glass spring to resist the effect of a low temperature. To enable us to determine the second question, namely, the power of resisting the shock arising from the discharge of cannon, the lords commissioners of the Admiralty were pleased to order the experiment to be made on board H. M. S. Excellent at Portsmouth. The Rev. George Fisher superintended these experiments, and their results are shewn by the following.

TABLE I.

13 Sept. 1833.	Distance of Chronometer from a 24lb. gun, shotted.	Number of discharges.	Situation of Chronometer with respect to gun.	Effect produced on Chronometer.
Expt. 1	42 feet	3	Placed bare on the deck abreast of gun.	None
2	32 —	3	Do.	Do.
3	20 —		Do.	Do.
4	15 —		Do.	Do.
5	12 —		Do. on the carriage of the adjacent gun.	Do.
6	Broadside from the main-deck guns shotted.		Do. on the lower deck, 9 feet below mid-ship main-deck gun.	Do.

Signed, GEORGE FISHER.

Having by these experiments established the conclusion, that the fragility of glass was no obstacle to its application to the purpose of forming the balance spring of a chronometer, our next step was to ascertain at what degree of tension a glass spring would break. We made a glass spring for this purpose, and applied it to the balance of a chronometer. It was wound up to 360°, detached from the escapement, and suddenly released, being shortened one coil at each trial. The following table will shew the result:—

TABLE II.

Degrees of Tension.	Number of turns in Spring.	Results.
360°	12	None
Do.	11	Do.
Do.	10	Do.
Do.	9	Do.
Do.	8	Do.
Do.	7	Broke

As chronometers vary in their arcs of vibration from 180° to 220°, and as the glass spring was wound up 360°, and did not break until it was shortened to seven coils, we may fairly conclude that it would have performed the usual arc of 180°, even at the seven coils, without fracture. It will be remembered, that the glass spring was applied to a previously adjusted chronometer in our few first experiments; and in adjusting it for variation of temperature, we found that we had to deal with a substance, with the nature of which we were altogether unacquainted; for on applying the glass balance spring, an excess of compensation was found, and, after repeated alterations to reduce this excess, we applied the least compensation that could be afforded us by the usual balance. This was done by placing the whole of the compensating weight at the end of the arm of the balance, instead of attaching it in the usual way to the movable end of the arc of compensation, and, as the arm expands in a direct line from the centre of the balance, we supposed that our object would have been accomplished.

Having now only the compensation rim composed of the usual laminæ of brass and steel, and the weight being also placed at the extremity of the arm, where no curvature could be produced, to bring it nearer the centre, we found that the laminæ themselves, without any weight, produced an excess of compensation; we therefore determined on finding the amount of error in time arising from the spring when subjected to a variation in the thermometer from 32° to 100°, To arrive at this, we made a solid disk of glass, and, having removed the former balance, we applied the disk in its stead, and brought the chronometer under this arrangement to mean time at a temperature of 32°. Assuming that no error would arise from the glass balance by its diameter being increased by heat, the variation shewn when the thermometer was raised to 100° would be attributable to the glass spring only.

The temperature was raised to 100°, when to our astonishment, the chronometer lost only the small quantity of forty seconds in twenty-four hours: the experiments were repeated, and the same results obtained.

It next became an object of much interest to find the amount of error of a steel balance spring under similar circumstances. With this view, we removed a compensation balance from a chronometer, and replaced it with a glass disk. Having brought it to mean time at 32°, we raised the temperature to 100°, and the rate shewn was losing 385 seconds in twenty-four hours. We then followed up these experiments by trying a gold balance spring; also one of palladium; and their several results are shewn in the following table: the number of vibrations were 18,000 when the chronometer shewed mean time.

Metals.	Thermometer.	Loss in twenty-four hours.	Length of Spring.
		m. s.	Inch.
Gold	32 to 100	8 4	14 00
Steel	Do.	6 25	11 04
Palladium	Do.	2 31	11 34
Glass	Do.	0 40	15 00

This table shews that metal balance springs vary in their results, when under different degrees of heat, in the order in which they stand in a table of expansions; and with this conclusion we might have remained satisfied, had there not been such a wide difference between the results with the glass and the gold springs. This at once led us to consider that such a difference could not arise entirely from an increase of length in the springs caused by direct expansion, but principally from a loss of elasticity occasioned by change of temperature.

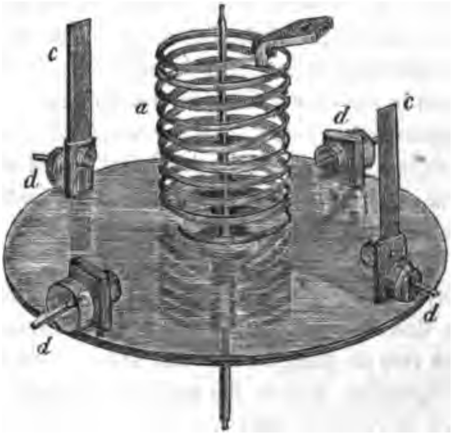
Our attention was next directed to separate these two causes of error, and if possible to account for the anomaly between the glass, steel, and gold balance springs. We may naturally conclude, if these alterations in the rates of the chronometers arose entirely from an increase on the length of the balance spring, due to the change of temperature, that by shortening the spring by the same quantity by which it had been augmented by the increase of temperature, a very near correction would have been effected, (making an allowance for a very small change in the inertia of the balance.) This was by no means the case; the following experiment will shew that it arose principally from a variation in the elastic force of the springs.

We first measured the length of the steel spring, and, on referring to a table of expansions, we found that being 11.04 inch in length it would increase its length .0065, in a temperature from 32° to 100°. This quantity being so small, we therefore preferred .01 inch, being in excess of that given by the table. Having shortened the spring by this quantity, which we could determine by our gauge, and keeping the glass disk applied, we obtained the difference occasioned thereby in the rate of going at 32° and 100°, then reasoning from the table of expansion, that as the spring had lengthened .0065 inches, it was fair to conclude that we had reversed the order of going, and that the chronometer would then go at the same rate when at 100° that it had gone before 32°. Instead of this, we had only advanced towards it by less than one fourth part of the quantity, shewing that the variation in the rate of going arose chiefly from a diminution of the elastic force of the spring, as seen in the following TABLE—

Thermom.	Rate per hour.	Remarks.	Experiment.
	s		
32°	+ 5.74	Length of steel spring, 11.04 in.	1
66	— 1.80	Do.	2
100	— 10.30	Do.	3
100	— 7. 0	Spring shortened, .01 in.	4

Having shortened the spring for the fourth experiment, by .01 inch, if the difference of rate had depended on its length, it would have shewn the original rate of +5s.74 at 100°; instead of this, the rate was —7s.0, differing only 3s.3 from the former at the same temperature. To the decrease in length of .01 inch, therefore, is due the loss of 3s.3, while to the loss of elasticity is due the difference between 3s.3 and 16s.04, the whole difference of rate for 68°, i. e. +5s.74, at 32° and —10s.30 at 100°.

The fact having been proved, that glass does not lose its strength by heat in the same ratio as metals, and being now acquainted with the extent of its loss, which was 40s for 68° of Fahr. we next had to construct a balance suitable to correct so small an error, and our previous experiments having pointed out to us that a metallic balance was unfit for such a purpose, we continued to employ the glass disk *b*, as shewn in the annexed diagram—



to which was attached the glass balance-spring *a*. To the disk we applied in an horizontal position, two laminæ composed of platina, *c, c.* These pieces were in length 0.5 in., breadth 0.052 in., thickness 0.004 in. and weight 2 grains. The lightness and thinness of these pieces only allowed of one method of compensating for temperature, which was to cut off with a pair of scissors a small portion from the top, and to draw out the timing screws *d, d*, to bring the chronometer to mean time again, in consequence of the balance having been lightened by cutting off a piece from the compensation laminæ.

The compensation being completed, we next proceeded to test the isochronism of the glass spring; in which respect it was proved to be as perfect as any metallic spring. The whole of the adjustments being now completed, we finally tried its rate under different degrees of heat, from 12° to 100° Fahr., and are of opinion, that there was less error shewn than generally attends metal springs, under corresponding circumstances. The chronometer with this glass spring and balance, was sent to the Royal Observatory, agreeably to the order obtained from the lords commissioners of the Admiralty, in October, 1833.

There have been two causes why the investigation has been delayed; first, until the last winter, the thermometer did not fall sufficiently low to enable us to draw a fair conclusion; secondly, there has been an acceleration, on a gaining rate, since it has been placed on trial; and this has been the sole obstacle to the complete success of this experiment. This acceleration must, therefore, be a subject of further research: that it arises from some latent cause, would appear from the circumstance, that the two chronometers, placed on trial by order of their lordships, as well as others which we have had in our possession for private experiment, have gained nearly in the same ratio. Of the two chronometers tried by order of their lordships, No. 616 has been stationary at the Royal Observatory, and No. 790 on board H. M. S. Fairy, Capt. Hewett, employed in surveying in the North sea. On the close of the season, this latter chronometer was returned to the Royal Observatory, until required; therefore, (with regard to this chronometer,) we have both a sea and land rate. The annexed tables shew the going of the two chronometers. From these tables it appears that the chronometers gained most at the earliest period of their trials, and our object is to watch the termination of their acceleration.

If we might venture to offer some practical remarks on the nature of balance springs which have been subjected to the effects of fire in their construction, to increase their elasticity, we would add; that all springs, which have been subjected to this process, have, for a certain length of time, a decided disposition to accelerate progressively; and it would therefore appear, that some particular change invariably goes on in the spring after the operation of exposure to the fire, the nature of which we are at present very imperfectly acquainted with; but, from the few experiments we have made, we are convinced that glass is in every respect capable of being introduced into the manufacture of chronometers.

ART. XVI.—*Chemical Examination of Microlite;* by CHARLES UPHAM SHEPARD, M. D. Professor of Chemistry in the Medical College of the State of South Carolina.

FOR my description of this mineral,* I could command only a few minute crystals, the largest of which weighed but four tenths of a grain. Had these not been possessed of considerable regularity of form and at the same time afforded very uniform results in the determination of their hardness and specific gravity, I should not have ventured on referring them to a new mineralogical species. The recent examination however of three crystals of the same substance from Chesterfield, each weighing about five grains, completely establishes the description already given, and enables me to throw some light on the chemical constitution of the species.

A. A very thin fragment of one of these crystals was heated before the blowpipe; it turned lemon-yellow at the apex, but without having suffered fusion. The same piece dissolved freely in borax with much effervescence, and formed a colorless, transparent glass.

B. 24·5 centigrammes of the mineral, in the state of an impalpable powder, were heated to whiteness in a platinum crucible. It lost 0·5 centigramme; i. e. 2·04 p. c.

C. Another portion in powder was treated with sulphuric acid in a glass tube, and heat applied. No perceptible corrosion of the glass was observed.

D. A few centigrammes were digested, first in dilute hydrochloric acid and afterwards in dilute *aqua-regia* during several hours. The mineral was not sensibly attacked.

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* American Journal of Science and Arts, vol. xxvii. p. 361, and my Treatise on Mineralogy, Part second, vol. ii. p. 45.

E. 11·5 centigrammes of the ignited mineral (B) were mingled with 25 centigrammes of carbonate of potassa and heated to whiteness for fifteen minutes. An imperfect fusion in the mixture was the result. The porous mass assumed a pale bluish color. On the addition of water, it became obvious that but a small portion of the mineral had suffered decomposition. It was accordingly treated to a new portion of the alcaline carbonate, and the crucible maintained at a white heat for one hour. The fusion was now complete, and the mass on cooling assumed a delicate sky-blue color. It was separated from the crucible by means of dilute acetic acid.

F. The clear acetic solution gave no precipitate with acetate of lead, thereby evincing the absence of phosphoric acid.

G. Hydrosulphate of ammonia occasioned no troubling in the acetic solution, from which the absence of iron was inferred.

H. Oxalate of ammonia produced a cloudiness and a precipitate in the acetic solution; which was occasioned, as afterwards became more apparent, from the presence of lime and yttria.

I. The matter undissolved by acetic acid was digested for some time with hydrochloric acid. A part of the solution, on being treated with the hydrosulphate of ammonia, yielded a black precipitate which was insoluble in excess of the precipitant. It was therefore attributed to protoxide of uranium in the mineral.

J. The residuum left by the hydrochloric acid in I, was digested in hydrosulphate of ammonia. The solution was separated by the filter, and evaporated to dryness. Ammonia was added to the residuum and the clear solution treated with nitric acid; a yellow precipitate fell. Tungstic acid is consequently an ingredient of microlite.

K. Another portion of the hydrochloric solution (I) was treated with a crust of sulphate of potassa crystals and set aside for twenty four hours, at the expiration of which time a perceptible accumulation of fine white grains was perceived, thus proving the presence of one or more earths, forming double salts with sulphate of potassa.

L. The residuum after digestion in hydrosulphate of ammonia, (J,) was fused with six times its weight of carbonate of soda and heated to whiteness. To the clear solution obtained by boiling water on the fused mass, nitric acid was added. A heavy white precipitate fell; nitrate of silver also threw down a precipitate, which was insoluble in nitric acid. Tartaric acid produced no troubling in the aqueous solution. Columbic acid was thus found to be a constituent of the mineral.

Analysis.

A. 0·33 gramme of the mineral in the state of an impalpable powder was treated in a platina crucible with 1·50 bi-sulphate of potassa. After fusion for a few minutes over an alcoholic lamp, the crucible was carried to redness in the furnace. The color of the fused mass was yellowish white.

B. Water was boiled on the fused mass (A,) and the contents of the crucible transferred at once to a filter. The clear solution that passed through was treated with solution of sulphate of potassa. In fifteen minutes, a fine white granular precipitate appeared.

C. The insoluble powder, B, was treated with sulphohydrate of ammonia. Its color was thereby changed to greenish black with a tinge of blue. Hydrochloric acid was poured on until the powder became nearly white. After washing in boiling water, it was transferred to a platina crucible and after ignition weighed 0·37 gramme.

D. The ignited powder, C, was boiled for a few minutes with excess of carbonate of potassa, and then treated with hydrochloric acid, filtered, washed, dried and ignited. It weighed 0·255 gramme. A portion of it was fused with carbonate of soda before the blowpipe. The bead effervesced, and on cooling, became white and opake. Another portion was fused with borax. It gave a clear bead, and by flaming became white and opake.

E. The hydrochloric solution, D, was precipitated with oxalate of ammonia and the precipitate was heated to whiteness. It weighed 0·04 gramme.

F. The water boiled on the fused mass of the mineral and treated with solution of sulphate of potassa, B, was separated from its crystalline precipitate by means of a filter and set aside after having had its volume augmented by a saturated solution of sulphate of potassa. In a few days a precipitate of fine granular white crystals appeared. The fluid was treated with an additional quantity of sulphate of potassa, whereby the white precipitate was in part, perceptibly dissolved. The clear liquid was withdrawn and treated with ammonia. A light yellowish white flocculent precipitate appeared, which on ignition was greyish white, without a tinge of red. The quantity was too small to allow me to make any satisfactory experiments upon it; but the fact that the double salt it formed was not soluble in the solution of sulphate of potassa, shows that it could not be thorina or zirconia, while its not turning red on ignition proves that it was not oxide of cerium.

G. The precipitate not taken up by the solution of sulphate of potassa, F, was treated with hydrosulphate of ammonia and then with dilute hydrochloric acid. The hydrochloric solution was treated with solution of potassa and the precipitate ignited. Its color was greyish white, without a tinge of red. It weighed 0·03 gramme.

The foregoing results do not enable me to rely with confidence on the proportion of any ingredient except the columbic acid. The other principles I regard only as having been ascertained approximatively.

Columbic acid,	75·70
Lime,	14·84
Tungstic acid, Yttria, Protoxide of uranium,	7·42
Moisture,	2·04

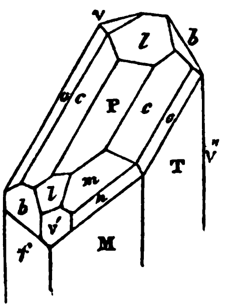
Charleston, Feb. 10, 1837.

Art. XVII.—*Notice of Eremite, a new Mineral Species*; by Charles Upham Shepard, M. D., Professor of Chemistry in the Medical College of the State of South Carolina.

Primary form. Right oblique-angled prism. M on T=140°30′.

Secondary form.

M on T ..	140°30′
P on M, or P on T	90 00
M on f .	92 10
—— n .	149 20
—— m .	130 20
—— b .	125 20
P on l .	150 50
—— m .	138 45
—— b .	127 10
—— v .	139 30
—— v′ .	132 15
T on o .	136 25
—— c .	117 40
—— l .	83 45



T on l′ .	96°15′
—— v′ .	118 30
—— v″ .	118 30
f on b .	143 8
—— v′ .	118 17
b on l′ .	140 26
b on l .	140 40
—— v′ .	141 16
—— v″ .	106 20
m on n .	160 35
—— o .	152 45
l on v .	156 10
c on o .	161 10
—— c .	151 35

Fracture conchoidal to uneven. Surface of the planes smooth and brilliant, T, M and b surpassing the rest.

Lustre resinous to vitreous. Color between clove and yellowish brown. Semi-transparent. Streak resembles color, but paler.

Brittle. Hardness=5·...5·5. Sp. Gr.=3·714.

Alone before the blowpipe, it instantly becomes transparent and colorless, but does not suffer the slightest fusion even in very thin fragments. Heated with carbonate of soda on a platina support, an opake white mass was obtained, stained in a single spot of a cinnamon brown color. With borax, it fused slowly, attended by a slight effervescence, and yielded a transparent amber-yellow globule, which by flaming became paler and milky in its clearness. Heated with sulphuric acid in a glass tube, after pulverization, it sensibly corroded the glass. It may therefore prove on more extended examination to be a fluo-titaniate, but of what base it is impossible to conjecture.

For my specimens of the above mineral, I am indebted to Mr. Thomas R. Dutton, a member of the senior class in Yale College. He discovered it last autumn in the northeastern part of Watertown, Conn. (on land of David Matoon,) engaged in a boulder of albitic granite, four feet in diameter. Mr. Dutton noticed the crystal figured above (which is still in his possession) while breaking up the mass for the purpose of obtaining black tourmaline, by which mineral the boulder was more or less penetrated. The crystal weighs but two grains, but is highly finished and perfect in its form,—all the faces admitting of the use of the reflective goniometer, by means of which instrument the angles quoted were obtained.

Mr. Dutton has again visited the locality this spring, and carefully reduced a part of the rock to fragments, without however being able to discover more than five or six extremely minute crystals, whose form is not very distinct. Two of these were employed in the blowpipe experiments above described. The mineral appears to be imbedded in the quartz and is accompanied by apatite.

As beds of this variety of albitic granite are common in the north part of Waterbury, in Watertown, Plymouth, and indeed generally throughout the mica-slate band skirting the frontier of the secondary in a northeasterly direction quite to the Massachusetts line, it is highly probable that other localities of this interesting substance will ultimately be brought to light.

The name bestowed upon the mineral is derived from ερημια, *solitude*, in allusion to the isolated manner of its occurrence, with respect to other individuals of the same species. Its properties obviously bring it within my genus eruthrone-ore, and in consequence of the replacement of both its longer and shorter terminal edges by three planes each, thereby giving rise to six prisms beside the primary, it may be designated systematically, *polyprismatic eruthrone-ore.*

New Haven, May 21st, 1837.

Art. XVIII.—*Description of Several New Trilobites;* by Jacob Green, M. D.

Genus Cryphæus—*Green.*

Body ovate oblong; convex; trilobate; contractile.

Buckler with two reticulated, oculiform tubercles.

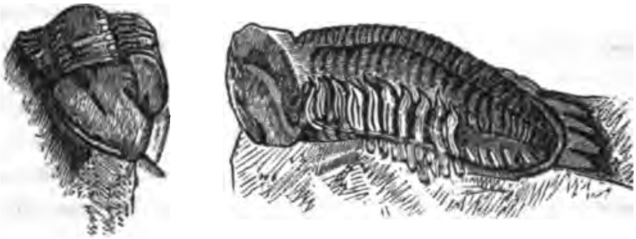
Arches of the lateral lobes sustaining a *second series* of ribs.

Tail elongated, membranaceous, lobate.

The generic term which we have applied to this proposed group of animal remains, is derived from the Greek, and is analogous in its signification to that of Calymene, Asaphus, Ogygia, and to some other appellations used by fossil zoologists. The head and the upper part of the body of these animals resemble those of the Calymene of Brongniart. A very slight obliteration of these fossils along the sides and round the tail, would give them all the characters of a Calymene, and perhaps some animals which have been described as belonging to that genus, will be found hereafter to belong to the present group. The genus Cryphæus is also, in some respects, very closely allied to Paradoxides, but as the *buckler* is furnished with tubercular oculiferous prominences, they cannot be confounded together. Professor Brongniart has indeed described, with a mark of doubt, the Paradoxides Laciniatus, as having eyes—*oculis marginalibus?* but should that interesting relique ever be discovered in a sufficiently perfect state to determine the question, it cannot, we suppose, be included in a genus, one of the principal characters of which is to be *blind.* Brongniart says of this group, "Les lobes latéraux (of the buckler) sons unis, et ne paraissent point porter d'yeux réels ni même de protubérances oculiformes." The P. Laciniatus is furnished with a lobate tail, somewhat like that of the Cryphæus, but it differs in many important particulars from any fossil that we have ever observed. Mr. De La Beche does not include it under that name in his list of Trilobites discovered in Europe, though according to Wahlenberg, it is found in Westrogothia. Professor Brongniart, has given, from Mr. Stokes, an imperfect drawing of a trilobite sometimes met with at Dudley in England, (plate 4, fig. 9.) which has some analogy in its form to the animals proposed to be arranged in our new genus, and Count Rasoumousky has figured and described a very remarkable relique, found on the Yaousa, near Moscow, which also has a somewhat similar aspect.

The second series of ribs, which proceed beyond the costal arches of the Cryphæus, we suppose will distinguish it from every other described genus.

CRYPHÆUS *Boothii.* *Green.*



Clypeo antice rotundato; oculis magnis; rugis tribus in fronte lateralibus; articulis septemdecim; cauda serrata utrinque in dentibus quinque divisa.

The general contour of this trilobite is that of an elongated oval; the body projects in high relief above the rock on which it reposes, and its whole length is rather more than two inches. The buckler in our specimen is partly wanting, but the front and one of the cheeks are still in a good state of preservation, and afford a pretty accurate idea of the whole head.

The *front* rises above the surface of the cheeks, is rounded and broad at its anterior part and gradually tapers towards the middle lobe of the abdomen. It is distinctly divided from the cheeks, and has three furrows on each side, near its upper edge. The lower furrow is the longest, and is nearly on a line with the inferior edge of the oculiferous tubercles on the cheeks. The middle furrow is the smallest, and appears as a deep depression or pit. The upper furrow is rather above the superior edge of the eyes. The anterior margin of the front is marked by a long curved sulcus, which has the appearance of a *lip*, as in the Calymene of BLUMENBACH.

The *cheeks* are in the form of spherical triangles. The oculiferous prominences are close to the front, and are placed just within the internal obtuse angles. The reticulated structure of the eye is quite perfect on the lower portion of the tubercle which still remains.

We have described the above as the head of our trilobite, though it is detached from the body; but as it lies in the rock just before and in contact with the anterior portions of the animal, there can be little doubt that it once formed a part of it.

The articulations of the *abdomen and tail* cannot be distinguished from each other; seventeen may be readily counted, and though our specimen is not entirely perfect, this number probably includes the whole. The middle lobe is quite prominent; is nearly equal in breadth for about two thirds of its course, and then gradually tapers to an obtuse tip. Most of the ribs, or costal arches, are, in our specimen, beautifully distinct. There is a little furrow scooped out of the upper surface, commencing at the middle lobe and terminating near their outward extremities, which are rounded and separated from each other, forming on the sides of the animal a denticulated line. Beyond these costal arches, there projects a second series of shorter ribs; these commence between the outward extremities of the first series, and gradually widen towards their termination. These appear intended to support a membranaceous expansion round the body. Unfortunately our specimen is rather obliterated on the sides, but still small curved spinous prolongations, may be seen in some places to terminate the second series of ribs, and will probably be found, in more perfect specimens, to project beyond the lateral margin of the abdomen on both sides.

The *caudal end* is very peculiar. The last five costal arches of the tail, terminate abruptly in a narrow membranaceous edge, which appears to be continuous with the expansion that surrounds the body. Its external border is finely ornamented with five leaf-like scollops on each side; the points of the leaves are free, and all curve towards a smaller leaf or lobe, which originates from the central portion of the tail or terminal joint of the vertebral column. At the fifth costal arch, counting from the tail towards the head, where the leaf-like appearance of the caudal membrane commences, the second series of ribs, which rise between the extremities of the costal arches, terminates. In our specimen, but three of the leaf-like scollops on one side remain perfect; the origin of the other two is, however, very obvious.

This magnificent trilobite was found near the town of Huntingdon, in Huntingdon County, Pennsylvania, by Professor James C. Booth, to whose kindness I am indebted for an opportunity of describing it. The specific name is given in justice to the discoverer, whose eminent skill in geology, mineralogy, and in analytical chemistry, entitles him to a much higher distinction.

In the cabinet of my friend, Dr. R. M. S. Jackson, there is a fragment of this species displaying the remarkable organization of the caudal end, and a person residing at Huntingdon has another specimen; all were found in the same locality. The rock in which they occur is a ferruginous clay slate, filled with other petrifactions. My friend JOHN F. FRAZER, Esq. informs me that the geological structure of Huntingdon and its vicinity, belongs to the classification of rocks, called by Professor ROGERS, in his annual report as State Geologist, the *olive slate stratum*. This stratum reposes on a coarse grained sandstone, full of organic remains, and is thus described in the report.

"The next stratum is a dull olive colored slate, alternating with grey argillaceous sandstones. Towards the upper portion some of the layers consists of a soft, very yellow slate, which increases as we ascend, becoming, in the upper part, the principal variety. It alternates with beds which gradually assume a brown and reddish tinge, that grows gradually more distinct, indicating the gentle passage of this rock into the red argillaceous stratum above it. The inferior layers contain occasionally large deposits of a very argillaceous iron ore, approximating in its composition and characters to the argillaceous iron stone of the coal measures. This stratum abounds also in mineral springs, the predominating ingredient of which is sulphuretted hydrogen. It may for convenience sake, be called the *olive slate stratum*."

CRYPHÆUS *Collitelus*. *Green*.

Cauda utrinque in lobis quinque divisa; lobis elongatis, rectis, acutis.

I have seen the caudal end only of this exceedingly interesting trilobite, but it differs so much from the other species described, that there is little doubt of its being distinct. There are eleven or twelve articulations of the vertebral column, and but five of the costal arches of the sides visible in our fragment. The joints of the middle lobe of the back are narrower, more numerous, and by no means so prominent as those of the C. *Boothii*, and the terminal joint is also much smaller. The costal arches or ribs of the sides are remarkably broad, and are strongly marked by a deep sulcus running along their inferior edge; they commence at the seventh joint of the vertebral column. The scollops or leaf-like lobes of the tail are five in number, and are remarkably large in proportion to the body of the animal; they form a regular continuation of the last five arches of the sides, and terminate in free points, without any curvature. A thin rib passes from the tip of each lobe through its middle to the sides of the animal, probably for the purpose of giving strength to the large development of the membrane. The body of the animal is broad, and a good deal depressed. The breadth of the fragment is one inch, and the length nearly half an inch.

I received this fossil from my friend, Dr. R. M. S. Jackson, of Alexandria, Huntingdon County, Pa. It occurs in a soft ferruginous slate, through which some sparkling particles of iron pyrites are sparsely disseminated. It was accompanied by five specimens of the C. *Boothii*, some of which were coiled up in the manner of the Calymene; the leaf-like lobes of the caudal membrane, in two of these specimens, were smaller than the middle leaf, and the outward angles of the buckler in one were perfect, extending down the sides of the animal, to the fourth abdominal articulation, where they finished in a rounded termination.

Trimerus *Jacksonii*. *Green*.

Clypeo? corpore convexo; cauda suborbiculari, costis lateralibus, abdominis, lineatis.

I have in my cabinet five or six specimens of this species, but they are all portions of the caudal end. The most perfect fragment consists of nine articulations of the middle lobe of the back, with eight costal arches. The middle lobe is regularly conical and much flattened, all the joints being broad and smooth on their upper surface. The ribs of the sides are also broad, but they are strongly marked by a raised line running through the middle of each; this raised line appears to characterize all the lateral ribs of the body, and where the crustaceous shell remains attached to the fossil, which is evident in two or three instances, this line is very distinct and peculiar. The grooves between all the joints are narrow and very slight depressions. The tail is rounded.

This species resembles a good deal the T. *platypleurus*, but the raised line on the upper surface of the ribs, will be sufficient at once to distinguish them from each other. It occurs in a hard, compact blackish limestone, in Huntingdon County, Pennsylvania. From the same locality I have the head of a Trimerus, which no doubt belongs to one of this species, but until it is found united to some other portions of the animal, its description must be deferred. The specific name of this trilobite I have given in compliment to the discoverer, Dr. R. M. S. Jackson, whose researches in fossil zoology will continue to illustrate many obscure departments of the science.

Asaphus *Trimblii*. *Green*.

Clypeo? Corpore depresso; costis planis, parte marginali vix membranacea; cauda rotundata? brevi.

Our fragment exhibits eleven articulations of the abdomen, and nine of the costal arches, all in a good state of preservation. It presents another example of the fact, that the ribs of the side lobes do not always correspond in number and position with the articulations of the vertebral column.

Like most of the fossil animals of this genus, the head is mutilated or lost; yet what seems to have been a small fragment of the *front* or middle lobe of the buckler, lies on the rock at a little distance from the abdomen. It is marked by two deep curved, transverse plicæ or folds.

The body is much depressed; the middle lobe is slightly conical, and terminates in a very obtuse tip; its articulations are all regularly rounded and smooth. The costal arches are also rounded, and without striæ, grooves, or pustulations, and have the same breadth throughout; the lower ribs are slightly curved, and they all terminate very abruptly in the membranaceous expansion. This organisation of the Asaph is beautifully developed in our specimen;—the membrane is narrow, even and smooth along the sides of the body, forming a regular hem or border; at the central portions of the tail, it gradually widens and makes a short rounded projection. It is difficult to say, whether the whole caudal membrane is entirely perfect in our specimen, for there appears to be an acute point in the rock, formed by some animal remain, just beyond the rounded end of the tail. If this be a part of the animal, then the central portion of the caudal membrane is acute, and not rounded.

I am indebted to Dr. J. TRIMBLE, of Huntingdon County, for this species. This gentleman has contributed very much to the illustration of the geology and natural history of the interesting County in which he resides, and I take pleasure in calling this species by his name. It was found by him not far from his residence, in a buff-colored clay slate. I have examined a fine large fragment of what seemed to be our present species, in the possession of Professor OLIVER P. HUBBARD, of Dartmouth College; but as the membranaceous expansion, if it possessed one, is broken off all round the body, we could not fully determine the question. It also occurs in yellowish limestone, and was found, in company with the CALYMENE *Blumenbachii*, at Juliet, in the State of Illinois.

The ASAPHUS *Trimblii* resembles, in some respects, the A. *laticostatus*, but its depressed form, its narrow membranaceous border, and the regular breadth of its costal arches, with some other peculiarities, will on comparison, readily distinguish the two species. The

A. *laticostatus* occurs in the ferruginous sandstone, so common in Ulster County, in the State of New York; and the A. *Trimblii* is mineralized in the yellow slate, which probably forms one of the layers of the olive slate stratum, so abundant in Huntingdon County, Pennsylvania. Dr. James Trimble has presented me with some very fine fragments of the Calymene Bufo, found by him in this locality. The reticulated structure of the oculiferous protuberances in some of them, appear as perfect, perhaps, as if the animal were in a living state.

Art. XIX.—*Remarks on the supposed connexion of the Gulf Stream with opposite currents, on the coast of the United States;* by William C. Redfield, Corresponding Member of the U. S. Naval Lyceum.

From the Naval Magazine.

It appears from numerous observations which are recorded in the American Coast Pilot, that immediately contiguous to the borders of the Gulf Stream on the North American coast, a moderate current is generally found setting to the southward and westward, or in the direction which is opposite to the stream, and parallel to the general line of coast. By a natural and familiar association, this current is generally styled *an eddy current;* but we shall probably find, on more particular inquiry, that it has little or no claim to this character. An eddy, as is well known, is usually caused by some fixed obstacle opposed to a stream, and is strictly local, and nearly circular in its action. Moreover, it derives its waters directly from the parent stream, and necessarily partakes of the same temperature. For the following reasons, therefore, I must dissent from the views of those who refer this counter-current to the eddying action of the Gulf Stream.

1. Because this current, in open sea, no where assumes the *form* of an eddy, but, when unobstructed by violent winds, maintains its course towards the southwest, on a line which is parallel to the general direction of the coast.

2. Because, on the outward edge of the Gulf Stream at least, there are no obstacles presented which could divert the progress of that portion of the stream, and circumscribe the same in eddies.

3. Because, if this current were derived from the Gulf Stream, it must necessarily partake of its temperature; but the sudden reduc-

tion of temperature on leaving the margin of the stream is most remarkable, and is almost unparalleled except in the immediate vicinity of ice.

We shall in vain attempt to explain this extraordinary change of temperature by the proximity of shallows or soundings, for this cannot avail if the water itself be derived from the gulf current, to say nothing here of the general unsoundness of this explanation.

I have long since become satisfied that the current in question is neither more nor less than a direct continuation of the polar or Labrador current, which bears to the southward the great stream of drift ice from Davis' strait, and which, in its progress to the lower latitudes, is kept in constant proximity to the American coast by the dynamical law or influence which, in the northern hemisphere, causes all currents which pass in a southerly direction to incline towards the west, in consequence of the increasing rotative motion of the earth's crust in the opposite direction, as in the case of the trade-winds in the lower latitudes.

In collating the observations of various navigators which have been published, we find reason to conclude that, in ordinary states of weather, this current may be traced from the coast of Newfoundland to Cape Hatteras, and perhaps to Florida, the reflux influence which follows a violent gale being of but short duration.

According to this view of the case, the Gulf Stream, in its course from Florida to the Bank of Newfoundland, is for the most part imbedded or stratified upon a current which is setting in the opposite direction in its progress from the polar regions. The impulses by which these diverse currents are maintained being, however, as permanent and unchanging as the diurnal rotation of our planet, their opposite courses on this coast while in contact with each other, are no more surprising or inexplicable than the case of two opposite currents of the atmosphere, and the latter are often known to maintain opposite courses for a long period, and at high velocities, while thus superimposed one upon the other.

From the fact that these great currents have their origin, one in the tropical and the other in the polar seas, their presence can be unfailingly identified by means of the thermometer; and with the aid of good chronometers their position and extent may be determined with greater certainty than has yet been done, particularly in the latitudes between Nantucket and Florida. In this department of hydrology, every navigator may contribute something of value to his profession and to science, for which no other qualifications are required than frequent observations, and proper attention to the ship's place. It is desirable, therefore, that every ship-master who traverses this region should make and record his observations hourly upon these currents.

The drift ice from the polar basin is always found in the western portion of the North Atlantic Ocean, notwithstanding the influence of violent westerly winds. A writer in the London Nautical Magazine* supposes that a portion of the polar current which bears the ice along the eastern edge of the Grand Bank into the Atlantic, there becomes exhausted, or joins the Florida stream. And in the Encyclopedia of Geography,† it is stated that the waters in the Northern Ocean, in the space comprised between Greenland and the coasts of Britain and Norway, and between Labrador and Spitzbergen, are supposed to perform a perpetual circuit; and that, being returned to Newfoundland, they recommence their revolution.

It is doubtless true that the great stream of ice is brought by the Labrador current within the dissolving influence of the Gulf Stream; and I may here remark that it is not improbable that the Grand Bank owes its origin to the deposits which have resulted from this process during a long course of ages.‡ But the polar current probably

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* Nautical Magazine for March, 1837, p. 139. In this article it is stated that between 42° and 43° west, is the farthest easterly position in which floating masses of ice have usually been found.

† Phil. Edition, 1, p. 196.

‡ It is not intended by this remark to express any doubt of the well supported theories of elevation which are maintained by modern geologists. That large masses or blocks as well as smaller fragments and masses of earth, are removed from the rocky cliffs of the northern regions by the icebergs, and transported by these floating masses upon the bosom of the ocean, is a fact which has frequently been noted by scientific navigators and goes far in support of the above suggestion.

To the writer it appears that the remarkable transfer of blocks and boulders from northern rocks to more southern positions which is so universally observed in the United States, and in the northern countries of Europe, may with great probability be attributed to the transporting effect of ice aided by the polar currents, during the long period when these countries were in a state of total or partial submersion. A block pertaining to the feldspathic formation of the Blue Mountains west of Lake Champlain and weighing perhaps fifty tons, is found on the west side of the Hudson at Cocksackie, about one hundred and twenty miles south of the original position. Smaller fragments of the same rock have also been noticed by Lieut. Mather in his geological report as being found in Orange County N. Y., and the writer is informed that they are even found in the state of New Jersey, near two hundred and fifty miles from their place of origin.

Mr. Lyell has fully recognized this mode of natural transportation, and shows that it is adequate to produce very extensive results. He shows also that icebergs "joins" the Florida stream in no other manner than by passing underneath the same, or yielding it a passage upon its bosom, the order of superposition being mainly determined by the great diversity of temperature. The icebergs being thus carried southward by the deeper polar current, even after the latter has lost its influence at the surface, their dissolution is speedily effected by the tepid water of the Gulf Stream, and we are thus relieved from these dangerous obstructions, which would otherwise be found in lower latitudes of the Atlantic. These two streams of current, therefore, neither meet nor coalesce in any proper sense; but like other currents, both atmospheric and aqueous, pursue each its determinate course, the Gulf Stream being thrown eastward by the greater rotative velocity which it acquires in latitudes nearer the equator; and the polar current being thrown westward along the shoals and soundings of the American continent and its contiguous ocean depths, by the more tardy rotation which it derived in higher latitudes.

The writer in the Nautical Magazine above alluded to, supposes the natural course of the polar current from Davis' Strait to be towards the coast of Moroçco, in North Africa; but a little attention to the effect of the earth's rotation on this current, will show that both it and the ice-drifts which are borne on its surface, must tend westwardly as above described, in despite of the powerful westerly gales which prevail in these latitudes. Light articles, however, such as bottles which are set afloat to determine the drift of currents, will not only yield greatly to the influence of these winds, but on falling into the surface current of the Gulf Stream will of course accompany this current in its progress towards the coasts of Europe, where a leading branch of this stream is found sweeping along the coast of Norway towards the recesses of the Polar Sea, and which appears to be ultimately resolved into the Labrador current. The south-easterly branch of the stream, on leaving the Grand Bank, yields to the centrifugal influence of the earth's rotation and consequently assumes the shorter and more direct circuit of gravitation by the coast of North Africa to the tropical latitudes, from whence it again merges in the Florida stream. It is by this system of compensation, aided by various subordinate gyrations, such for instance as Rennell's cur-

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are met with in the southern ocean in a lower latitude than that of Philadelphia. But geologists do not seem to be fully aware of the permanent character and extent of the great polar currents, which, under successive changes of location, must have prevailed from the beginning, in both hemispheres.

rent, that the great mechanical system of oceanic circulation is apparently maintained, and which, with the operation of like causes in the atmosphere, may be supposed to have a powerful influence upon the climate of western Europe. Were the influence of winds wholly unfelt upon the ocean, it is probable that the same system would continue to be maintained, in all its essential features, by the mechanical influences of the earth's rotation combined with an unstable state of equilibrium. The energy of this rotative influence, by which the earth is flattened about twenty seven miles in its polar diameter, and the depressive force of which, in each polar basin, is equal to that of a column of mercury more than five thousand feet in height, is at least sufficient to maintain the existing movements and mechanical relations of the terrestrial fluids, under the various and continued oscillations to which these fluids are necessarily subjected.

One fact, too important to be omitted here, will serve to demonstrate the course and identity of the great ice-current for more than half the distance from Cape Race in Newfoundland to the coast of Massachusetts. On the 7th of July, 1836, H. M. packet Express passed between two large ice islands to the southward of Nova Scotia, in lat. 43° 13′ N. lon. 61° 17′ W., temperature of the water 42 degrees, depth 45 fathoms; the most western of these icebergs being in lat. 43° 09′, lon. 61° 26′, or about 75 miles southwesterly from Sable Island.

From the temperature of the sea upon the North American banks and soundings, and in some other positions which are deemed analogous, it has been assumed that the mean temperature of the sea is lower on shoals than in deep water, but it seems difficult to account for such a result, unless upon the ground already mentioned. It has, indeed, been ascribed to radiation from the bottom; and again, it has been denied that radiation from a non-luminous body can be carried on freely through the water, and as the colder particles have no tendency to rise towards the surface, it does not appear how the supposed reduction in the temperature of the bottom can materially affect a current of fifty or twenty fathoms in depth, which is derived from a foreign source; for on none of these shoals or soundings, is the water permanently quiescent. Were it otherwise, we might reasonably expect a diminution of temperature on shoals in winter, and an increase in summer, with a permanent increase, if in tropical latitudes. I am informed by George W. Blunt, Esq., who has made a course of regular thermometrical observations while crossing the Atlantic, that on entering upon soundings in the English Channel, he has found an increase of temperature in the water of 2° Fahrenheit. Those who differ from our views in regard to these currents, ought, therefore, to propose some hypothesis which will account for the extraordinarily low temperature of the waters which lave the Atlantic coast of the United States. Were these waters derived as an eddy current from the Gulf Stream, it is probable that they would no longer serve for the myriads of codfish which now frequent our shores, and which appear to inhabit the coldest waters.

Many experiments upon the drift of currents have been made with bottles containing memoranda of the date and locality in which they were committed to the sea. These experiments are not without their value, although it is obvious that a circuitous course is liable to be construed into a direct one, and that violent winds may greatly affect the course of such objects upon the surface of the ocean, while an important diversion may also result from a superficial cross current, as we have already noticed in the case of the Gulf Stream. Perhaps the suspension of some suitable weight to these floating messengers, with a line from five to twenty fathoms in length, would afford results of a more satisfactory character; although the duration of such pendulous fixtures can hardly be relied on. If fitted in this manner, the fact should be noted upon the memorandum inclosed, which should specify also the length of line which may be attached.

A full knowledge of the general system of currents in every ocean is obviously of great value to the nautical profession, and is important, also in its relations to physical science. It is hoped, therefore, that these considerations will prove sufficient to stimulate our navigators to make and record the necessary observations, and to promulgate the same through the proper channels of information.

ART. XX.—*On the use of the Dynamic Multiplier,** *with a new accompanying apparatus;* by C. G. PAGE, M. D.

THE multiplier used in these investigations is composed of three hundred and twenty feet of copper ribbon, one inch wide, wound into a flat spiral with a single strip of varnished cotton to insulate the coils. It has ten mercury cups soldered at various distances from the center. It must be premised, that in using large batteries with this coil, the maximum results by the induced current, are obtained by including only a portion of the coil in the direct circuit. With small pairs of plates the whole coil should be used.

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* As the instrument in its generalized form as described in a previous No. of this Journal, has become a very useful piece of apparatus, it is proper it should have a name. As the phenomena exhibited by this instrument belong to the class called Electro-dynamic, by Ampere, I have selected the term Dynamic Multiplier.

A small pair of plates connected with this multiplier, deflects a delicate needle at ten feet distance.

Twelve pairs of plates arranged as an alternating series produce far more powerful results, than the same elements arranged as a calorimotor. The direct current is slightly augmented by passing through the coil. When the circuit is broken with a blunt pencil of zinc or lead, the spark appears of the size of a large pea, with a very loud snap. When both the connexions with the coil are broken simultaneously, two equally bright sparks are produced, while a third spark occurs in the induced circuit. Fifty pairs of plates give no brighter spark than twelve, and three hundred not so bright. Charcoal points, in the induced circuit, give a vivid spark, provided they do not quite touch. If directly in contact, the action of the coil is nearly lost as the current passes directly through the charcoal. This shows the reason why the induced current is stronger, when half or more of the coil is included in the direct circuit, than when the whole is used; in the latter case the lateral circuit is so short, that the battery is partly discharged through it.

It is not impossible that the arch of light may be produced in the induced circuit, if the rupture of the direct circuit could be made commensurate with the velocity of the current.

To effect decomposition, it is desirable that the circuit should be broken with great rapidity. To attain this I have tried a variety of means and succeeded in the contrivance of several beautiful pieces of apparatus.

Barlow's spur wheel answers very well where large batteries are used, but not for small. A stellated wheel, connected by a band with a multiplying wheel, answers exceedingly well; but as independence of action is a great beauty and convenience in experiments, it must give place to the following self regulating instruments.

Ritchie's revolving voltaic-magnet, which has recently come to us in connection with Daniell's and Mullen's constant batteries, makes a good interruptor. Fitted with a glass cell for the mercury, made by sections of tubes, it becomes a pleasing and useful apparatus. Placed upon the box containing the multiplier, it turns rapidly without the magnets, merely by the action of the coil. The pieces of wood separating the mercury floods, or poles of the battery, should be arranged in the direction of the radius of the coil, as that is the position of equilibrium for the magnet. The opposite poles of a magnet, conspiring with the action of the coil, make the revolution extremely rapid. The interruption occurs twice in each revolution, but it may be made more frequent if the number of partitions in the cells be increased, and the magnetic poles in like manner. This instrument is liable to one objection. The mercury is often dragged across the partitions and the revolution ceases. This may in part be obviated by pouring a little water upon its surface.

Fig. 1, is a representation of a vibrating interruptor of my own invention. A piece of soft iron wire one eighth of an inch in diameter, and three inches long, is covered with copper wire, and made to vibrate rapidly between the poles of a horse shoe magnet. It should be carefully suspended and well balanced. Its motion is increased if the poles just touch the wires, to give the bar a spring. The cups for mercury (*p* and *n*) are sections of glass tubes; *r* is a thumb screw for regulating the vibrations of the bar. If the four ends of the wires be carefully adjusted near the surface of the mercury, by bringing down the screw upon the bar, the vibrations may be rendered inconceivably rapid.

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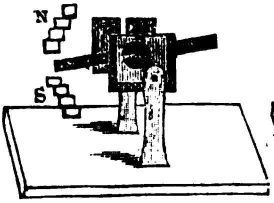

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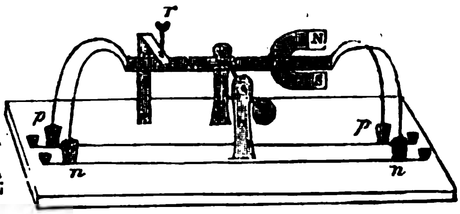

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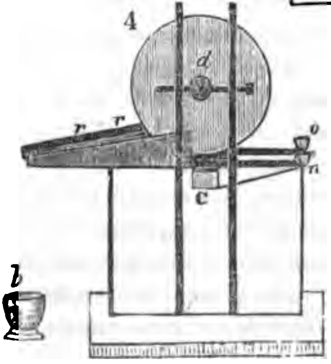

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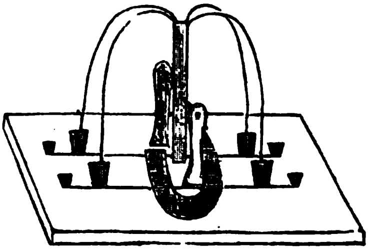

Fig. 2, is an oscillating interruptor differing from the last only in the mode of suspension.

There are two ways of arranging the wires, so as to produce motion by changing the direction of the current. A single wire may be used having two extra ends, which are to be carried to the other extremity of the bar and crossed before reaching the cups. In the oscillating interruptor the extra ends are soldered to the ends of the wire, at the same extremity of the bar, viz. the top. The other method is to cover the bar with two wires running in different directions.

Fig. 3, is a side view of a revolving interruptor, which is to be preferred to all other forms.

The bar may be of larger size and have a brass rim attached to it, to make its motions more regular; two bars at right angles may be used to increase its speed, but one will be found sufficient. The extremities of the wires are brought down upon the axis, and soldered to upper and lower pieces of copper, which are segments of circles, for dipping into the glass cells for mercury. Single wires will answer. There are three methods of changing the direction of the current. First, by using two coils of wire running in different directions; 2d, by using a single coil and having four mercury cells, two positive and two negative, and lastly, by having a single coil and two cells; the extra ends are attached, and crossed on the axis. I have tried all these methods, and prefer the last. A single horse shoe magnet held any where near the extremity of the bar, will keep it in rapid revolution. The most proper disposition of the magnets would be in a circle, having all the poles of one kind in the upper, and all of the opposite kind in the lower half. The revolution is so rapid as to scatter the mercury, if the cells are not sufficiently deep: they are made each of four strips of window glass, having sufficient space between them at the center to allow the axis to pass. The tops of the cells are then covered, and the spaces between the glass strips closed, except where the axis passes. (The mercury is rapidly oxidized, but the oxide may be saved (as it should be in all cases) and dissolved in nitric acid, for use in small batteries. The nitrate of mercury is far superior, as a motor of electricity, to acids or the cupreous salts. A single pair of plates, the size of a cent, each separated by a strip of gold beater's skin, immersed in the nitrate of mercury, give results by the dynamic multiplier, equivalent to a battery of four square feet of common construction. If the zinc plate be entirely protected by gold beater's skin, the whole of the mercury may be recovered by precipitation on the copper plate in its metallic form. Pairs of plates of copper and iron, copper and lead, lead and zinc, or iron and zinc may be used, but copper and zinc are preferable.) As a still further improvement in the revolving interruptor, I have attached a short shaft to its axis, which carries two wheels, one entire and one stellated. A small battery is used to move the interruptor, while the circuit of the battery used with the coil is broken by the star wheel of the attached shaft; the entire wheel turning in mercury preserves the connexion. The velocity of this interruptor is very great, and when viewed in the night by its own light, the whole apparatus appears to be at rest. When decompositions are performed with the multiplier and interruptors, the acidulated water is put in a glass tube, with platinum wires passing in at the ends and running parallel to each other for an inch or two, and about one fourth of an inch apart. A fine tube passes through one of the corks to allow the water to escape. Fine wires answer better than large.

On the thermo-electric spark and shock.—The six outer circles of the dynamic multiplier, connected with a single thermo-electric pair, give a bright spark, when the circuit is broken with a clean pencil of zinc or lead. The snap is very audible, and the shock distinct, by acupuncture.

Ignition of anthracite coal by the deflagrator.—Anthracite becomes a good conductor when heated, and becomes intensely ignited between the poles of the deflagrator, if the following method be adopted. Pencils of the coal being attached to the poles, the ends of a piece of copper wire bent in the form of the letter U are placed on either side just where the coal is in contact with the poles; the wires are then slowly approximated on the coal points, which soon glow with a brilliant white light, and afford a short arch.

On the use of the metals as substitutes for copper in batteries excited by the cupreous salts.—As the copper plate serves only for a conductor of the electricity put in motion, any metal having the same electrical relation to zinc as copper, must be an equivalent, provided its conducting power be as good; but where plates of metal of no great length are used, this difference must be inappreciable. The activity of such batteries is commensurate with the decomposition of the metallic salt; and as iron or lead precipitates metallic copper from its solutions, the decomposition in the batteries might be facilitated by the introduction of these metals. As the results of a number of experiments, I conclude, that iron when clean and freshly immersed in sulphate or nitrate of copper with zinc, is as good as copper. But its liability to oxidation is an objection to its use. Lead answers very well. I have batteries which were made of lead and zinc plates nearly two months since, and have used them often. Their power seems to improve by use. The lead plate becomes covered with metallic copper on the side towards the zinc. Lead plates excited by sulphate of copper, will answer for compound batteries. Mercury answers as well as copper. Bismuth and antimony, also make a good series with zinc. Brass is nearly equivalent to copper. Zinc with zinc makes a tolerable battery, provided one of the plates much exceeds the other in surface. The plate answering for a conductor, should be cut so as to leave narrow parallel strips. Other metals have not been tried. A very active arrangement is made by the nitrate of mercury and suphate of copper, separated in a cell by a strip of membrane; the connexion is made by two strips of copper immersed in each cell.

In copper or lead batteries, where the salts of copper are used, the zinc plate should be movable, in order to clear it from the copious deposit. To effect such an arrangement, and to give the battery at all times the benefit of fresh immersion, I have contrived a revolving plate battery.

Fig. 4, represents a side view of the revolving plate battery. The zinc plate is raised from the box lined with lead or copper holding the solution of the sulphate. The plate is of thick cast zinc, a foot in diameter: *d*, is a copper disc attached to the axis of the zinc plate, and when the plate is lowered, turns in a narrow mercury cell, C, fixed to the side of the box, and connected by a strip of metal with the mercury thimble, *n*: *r*, *r*, are two deeply grooved, inclined rubbers on each side, to strip and lead off into the bowl *b*, the deposit from the zinc plate. That side of the rubber which presses against the zinc plate, is covered with leather, and the pressure is regulated by springs. After the zinc wheel has been immersed a minute or two, it is turned over by its crank, which is on the side opposite the copper disc, *d*. This battery combines the following advantages, viz. the zinc plate and exciting liquid are kept clean, both surfaces are opposed to the copper or lead plate, the conducting plate exceeds the other in surface, the zinc plate will last a great length of time, if properly turned, as only half of it is immersed at once, and above all, if the zinc wheel turn accurately, it may come very near the conducting plate; whereas in batteries where the zinc plates are permanent, considerable distance must be preserved, on account of the filling up of the intervening space by deposit. A vast amount of electricity is lost, by this necessary defect in common batteries. The battery I have, has a lead cell, and can be depended upon at all times, for a regular and powerful current. Any number of parallel plates may be mounted upon the same axis, and be used as a simple or compound battery.

When the battery is not in use, the zinc wheel is raised and supported between the upright pillars, by two cross bars.

Salem, Mass. April 19th, 1837.

P. S. In my communication a few days since, I omitted to mention the form of constant or protected battery, of which I sent you a model. The truth is, it does not answer my expectations. When first used, it was active and serviceable from its economy, but time has proved it to be inferior to that of Mullen. As however I have tried a great variety of forms, with a view of determining the best, a few remarks may prove acceptable.

On the use of protected batteries.—That which is known as Mullen's, where the copper cylinder is surrounded with membrane, containing sulphate of copper, and the zinc plate outside, immersed in some alkaline salt, appears to be the most active form of protected batteries. But this battery is somewhat simplified, if the zinc plate be protected in the same manner as the copper plate, and the copper be made a tight cylinder, holding the sulphate. A considerable saving is made, if the surface of the zinc plate not opposed to the copper, be varnished or painted. The most active arrangement yet tried, is made by using the nitrate of mercury as a substitute for the salts of copper. The power of such a battery is so great, that the size may be very much diminished for common experiments. Cylinders of copper, two inches high, and an inch and a half in diameter, are sufficiently large. The arrangement is the same as in Mullen's battery, with a few exceptions; the outer surface of the zinc cylinder is varnished or painted, and likewise the inner surface of the copper cylinder; this last condition it is very necessary to observe. A little battery of this description has been immersed without being replenished seventy two hours, without any perceptible diminution of action. The solutions used, are nitrate of mercury in the copper cylinder, and nitrate of potash for the zinc. The great superiority of this battery over the sulphate of copper batteries, is due to the co-operation of an independent chemical or electrical action, viz. the decomposition of the metallic salt by the copper plate itself.

Salem, April 24th, 1837.

ART. XXI.—*Description of the Skull of the Guadaloupe Fossil Human Skeleton;* by JAMES MOULTRIE, M. D., Professor of Physiology in the Medical College of the State of South Carolina: *with introductory remarks;* by C. U. SHEPARD, M. D.

MY attention was called during the last winter to some portions of a human fossil in the museum of the Literary and Philosophical Society of South Carolina by Mr. JOHN D. LEGARE, by whom I was informed that they were brought from Gaudaloupe and were undoubted parts of the much valued skeleton in the British Museum, of which so faithful a description was given by Mr. KÖNIG in the Philosophical Transactions for 1814, vol. CIV. p. 101. Having received from Mr. KÖNIG many years since a sample of the block in which the skeleton was imbedded, I was able on the first inspection to satisfy myself, that a perfect identity subsisted between the engaging rock in both instances; and on recurring to the paper of Mr. KÖNIG, it appeared that the portions here existing are among those in which the British sample is deficient, viz. the cranial bones and the lower part of a thigh bone. It struck me as being an important inquiry to ascertain if possible from an examination of the shape of the skull, whether the received opinion respecting the Carib origin of the individual were correct; for although the determination of this point, is not likely to carry back the antiquity of the specimen to a very remote period, in opposition to the manifestly recent mineral character of the rock in which it is found, still the result may give it a more ancient date than has been attributed to it, and possibly throw important light on the connection of American races heretofore considered as distinct. I accordingly desired my colleagues, Dr. MOULTRIE and Dr. HOLBROOK, to bestow upon the skull a careful examination, with which request they were very ready to comply. The result as drawn up for publication by the former gentleman, constitutes the following paper. C. U. SHEPARD.

Charleston, May 30th, 1837.

These precious remains, were brought from Guadaloupe by Mons. L'Herminière, a naturalist, and placed (together with many other specimens relating to natural history,) in the museum of the Literary and Philosophical Society of South Carolina in August, 1816, from whom it was purchased, (in common with his collection) the succeeding November. They consist of five fragments of different sizes. The largest, is composed of portions of the temporal, parietal, frontal, sphenoidal, and inferior maxillary bones of the right side of the cranium. Saving part of the parietal near the anterior superior angle, the fragment is externally encrusted with the rough calcareous matter in which it was imbedded; while its internal surface being smooth enables us to trace upon it several important distinctive impressions. The temporal portion of this fragment is constituted of the whole of the squamous portion, the greater part of the petrous, and part also of the mastoid. On the first, appears the fossa for accommodating the middle lobe of the brain, marked by its convolutions, and the groove of the middle artery of the dura mater; on the second, the two surfaces, divided by the tentorial ridge, in the anterior of which is the hiatus of Fallopius, and in the posterior, the internal meatus, beyond which the bone is abruptly destroyed; and on the third, the deep, large fossa of the lateral sinus. This portion of the bone also exhibits impressions of the convolutions of the brain; on the lower surface, in like manner appears, the jugular fossa. The parietal bone is defective at its superior posterior part; and the external incrustation is wanting as low down as the parietal protuberance. The bony surface is rendered smooth by the removal of the deposit, exactly where it lies in apposition with this surface. Its internal face shows the marks of the cerebral convolutions, and the arborescent arrangement of the artery before mentioned. The diploic structure and tables of this bone are quite manifest at its irregular edges. The remaining frontal fragments are, the external angle and a small part of the orbitar plate —that part of it which is united to the apophysis of Ingrassias. The convoluted phenomena are somewhat apparent here also, and there are faint traces even of the coronal suture. The sphenoidal portion is apparently constituted of a small part of the greater wing, the cerebral surface of which alone is seen in the interstice formed by the temporal, frontal, and parietal divisions, composing the middle fossa. Towards the under side, imbedded within the calcareous crust, are two spots of cancellated appearance, which are probably the remains of the pterygoid process, and the alveolar edge of the superior maxillary bone which is in immediate contact with it.

The next in size is the occipital portion; the right half, separated from the left, by a vertical section passing through the middle of the bone. It is covered externally with the common crust, but is designated interiorly by the crucial ridge, part of the occipital foramen, the depressions of the lateral sinus, and the fossæ of the posterior lobe of the cerebrum, and of the cerebellum. Near the outer side of the occipital foramen, is the curved fossa of the lateral sinus, usually found just where that conduit is about to emerge from the cavity of the cranium. The diploic structure and tables are here also quite obvious at the vertical edge of the fragment.

Next, is the portion which may be taken for either a parietal or frontal fragment. I think it the latter, because, internally, it wants the arborescent features characterizing the lower half of the parietal bone, and is equally deficient in traces of the fossa of the longitudinal sinus declaratory of the upper; and with respect to uniformity of smoothness, and configuration, corresponds more closely with this bone than with the other.

The next is undoubtedly the mental portion of the inferior maxilla. This is indicated by its thickness, curvilinear figure, and the character of the alveolar processes and sockets; by the triangular tubercle at the bottom of the symphisis in front; and the mental tubercle and lateral fossa of the right digastric muscle behind; besides that the alveolar edge is sharp; the sockets, which are six in number, are single; and what is considered to be the base exhibits, very evidently, the usual close cellular conformation.

The last is obviously a part of the superior posterior angle of the parietal portion. It is the smallest fragment, and needs no particular description.

These relics have been supposed to belong to the head of an individual of the Carib race. This is undoubtedly a mistake. The anterior posterior diameter is too short, the occipital region too flat, and the lateral and vertical developments too full, upon a reconstruction of the cranium, to justify such a supposition. The following are the admeasurements, made jointly by Prof. Holbrook and myself. From the posterior edge of the occipital foramen to the concavity of the frontal bone behind the frontal sinus, five inches. From the same to the anterior superior angle of parietal bone, four inches and eight tenths. From the fossa of Sylvius to the same point, four inches and a half. From the center of the petrous ridge to the center of the cerebellar fossa, one inch and five tenths; and from the same center to the cerebral fossa, or the fossa of the posterior lobe of the cerebrum, two inches and one tenth. Compared with the cranium of a Peruvian, presented to Prof. Holbrook by Dr. Morton, in the museum of the Medical College of the state of South Carolina, the craniological similarity manifested between them is too striking to permit us to question their national identity. There is in both, the same coronal elevation, occipital compression, lateral protuberance accompanied with the frontal depression, which marks the American variety in general. Insomuch that were it possible to exfoliate, if I may so say, the fossil relics from their incrustation, the vacancies might be filled with the corresponding parts taken from the head of the Peruvian. Placing the maxillary fragment in apposition to the corresponding opposite alveolar row of this head, the physiognomy is such as to lead the imagination to view it as a fac simile of the original. JAMES MOULTRIE.

MISCELLANIES.

DOMESTIC AND FOREIGN.

1. *Annual Report of the Curators of the Boston Society of Natural History.*—Read at the Annual Meeting, May 1st, 1837; by D. HUMPHREYS STORER, M. D.

Your committee to whose duty it has fallen to report upon the state of the cabinet, takes great pleasure in congratulating the society upon its unprecedented prosperity. At no previous period have so many additions been made to our collections; or so much labor been bestowed by the curators upon their respective departments. Our hall has become a favorite resort for the community at large, and the naturalist finds here rich materials for study and improvement.

The number of donations the past year is one hundred and sixty, the number of donors one hundred; of these, we cannot refrain from mentioning the names of Mrs. A. A. Shattuck and Mrs. Thomas Say, and those of Messrs. Amos Lawrence, B. D. Greene, S. A. Eliott, David Eckley, Geo. B. Emerson, G. C. Shattuck, G. C. Shattuck, Jr. Wm. Ingalls, George Parkman, Charles Amory, Professor Hitchcock, Horace Gray, James Jackson, Francis C. Gray, Jonathan Phillips, John Randall, David Henshaw, J. J. Dixwell and J. B. Higginson.

The principal donations to the several departments, are as follows:

In Mineralogy and Geology.—A beautiful specimen of opalized wood from Hobartstown, S. S. Volcanic specimens from Fayal and stalactites from Ohio; but far more interesting than these, several original specimens, together with a series of casts, of the newly discovered ornithichnites or bird tracks of Professor Hitchcock, have been added to our cabinet.

The members of the society are well aware why so little attention has been paid to enriching this portion of our collections. All the cases appropriated to mineralogy, are filled with the valuable deposit of Dr. C. T. Jackson. It is however very desirable that the cabinet strictly belonging to the society, should be enlarged, that we may be prepared to supply the vacancy which would be produced by the removal of the collection before us.

Botany.—Although no addition of importance to the botanical department has been made during the last year, save a suit of plants collected in the neighborhood of Savannah, and presented by Mrs. Thomas Say, perhaps no portion of our collection has received more attention, or is becoming more rapidly, and at the same time, more thoroughly arranged, than this.

ZOOLOGY.—1. *Mazology.*—Previous to the last annual meeting, the body of an elephant weighing upwards of six tons was purchased by the subscription of several of our members. The time and labor required to prepare it for exhibition, prevented its addition to our collection many months since. Several gentlemen assisted in the dissection of the body; to our cabinet keeper alone, however, we are indebted for the completion of the perfect skeleton which ornaments our hall.

2. *Ornithology.*—The exceedingly curious and rare nest of the Ploceus Phillipensis; the eggs of a few of our birds; and a valuable collection of birds' skins, from India, from J. J. Dixwell, Esq. to whom the society have been previously greatly indebted, are the principal additions to our ornithological department. This portion of our collection now contains several hundred species, of carefully preserved valuable foreign birds. But we are compelled to add, in the *species of our own state*, the deficiency is very great. Singular as it may appear, that department of our natural history, the means of acquiring a knowledge of which are most ample, and within the reach of all; whose objects are most generally known, and all of which have been accurately and scientifically described, which are interesting not merely to the naturalist, but claiming alike the attention and admiration of the cursory observer, this department which might be made most beautiful, and as its species can *each* be procured, most valuable, has been unpardonably neglected.

Less than three hundred species of birds are found in Massachusetts. A specimen of each species might be procured and mounted for three or four hundred dollars, and yet there are our cases, empty.

3. *Herpetology.*—Several species of serpentia from Brazil, and Mississippi, and a choice collection of reptiles from India, have been added to the herpetological cabinet.

4. *Ichthyology.*—With the exception of a beautiful specimen of Lepisosteus from the Ohio river, presented by Dr. Emerson of Illinois, no additions, save a few of our own fishes, have been made to the collection of ichthyology. It would ill become your curator of the departments of ichthyology and herpetology to dwell upon this portion of his report: justice to himself however, requires he should remark in passing, that the pledge referred to by the gentleman who offered the last annual report, has been redeemed, and the reptiles, as well as the fishes, are scientifically arranged, labelled and catalogued.

5. *Entomology.*—To no department can we point with more pleasure or pride, than to that of our entomology. Each succeeding year has added new treasures to the cabinet, until it has become by far the most extensive and valuable in the United States. The following extract from an elaborate report kindly offered me by the curator of this department, will undoubtedly be gratifying to the society. "At the annual meeting in May, 1836, Dr. Gould reported the condition of the cabinet of insects, and the additions and donations which had been made to it. All the *diurnal* Lepidoptera were then arranged and named, and some progress had been made in arranging, determining and labelling the Coleoptera. About one half of the insects of this order are now finished, their names as far as they could be ascertained are affixed to them, and the species are arranged and referred to the new genera according to the catalogue of Count Dejean. The number of species now entered upon the catalogue amounts to two thousand one hundred and eighty, and when the remainder are added, the cabinet will contain at least two thousand and six hundred species of Coleoptera, without including those in the collection of Professor Hentz.

"The processes necessary to be gone through with the insects renders the work very slow and tedious. Many of the insects require to be cleaned; a large number are badly impaled, upon short, clumsy or crooked pins, and must therefore be softened so as to have these pins extracted and new ones inserted, and this delicate and hazardous process requires no little skill and patience in the execution; they are then to be determined, labelled and fixed in a box in order to be baked, an operation essential to their future preservation; and lastly they are to be placed in proper order in the drawers where they are to remain, with the names of the families and genera affixed to them.

"The drawers in which the Lepidoptera and Coleoptera are contained, I have supplied with strips of soft pithy wood to receive the pins of the insects; but having exhausted my supply, in preparing the drawers in the cabinet of the society, I have been obliged to suspend my labors until the remaining drawers shall be prepared in the same way; for experience has taught me the necessity of having the drawers lined entirely, or partially, at least, to receive the slender pins used for insects and render them safe in their places.

"The additions to the cabinet of insects during the past year consist of one box of Chinese insects, and one double box containing specimens from South America, both presented by Col Baker: nineteen specimens in spirit from Calcutta, presented by Mr. Dixwell: one hundred and fifty one specimens from the Cyclades and Marseilles, presented by Mr. Richards: one small box of specimens packed between layers of paper, collected in the island of Syra, and presented by the Rev. J. J. Robertson: and a box of Swedish Coleoptera, containing two hundred and forty one specimens from Mr. Fabræus of Gottenburg, sent for exchange through Dr. J. S. Copley Greene, in return for which, an equal number of specimens has been selected from our duplicates and sent to Mr. Fabræus.

"Mr. W. W. Wood of Manilla, from whom the society received, during the last year, three boxes of exceedingly valuable insects through the kindness of Mr. Russell, has in reply to a letter from me, offered to collect and send to us more insects from the Phillippine islands, if we will furnish him with boxes, pins and camphor; and I would recommend the society to embrace his liberal offer, and supply him with the means of executing it.

"Dr. Zimmerman, the author of a work on the Carabidæ, when here on a visit from the South, during the last summer, received from Dr. Gould and myself a large collection of the duplicates belonging to the society, in return for which he promised to send an equal number of species from the Cape of Good Hope, and other countries, the entomology of which is not yet represented in our cabinet.

"On the 18th of June, 1836, there arrived from New Orleans, the collection of Professor Hentz, sent to us in consequence of a negotiation with me for the purpose by subscription of this large and valuable collection for our society. If no mistake has been made in counting the insects there were fourteen thousand one hundred and twenty six specimens, one thousand three hundred and fifteen of which are foreign insects, leaving *twelve thousand eight hundred and eleven native insects.* Many of these are duplicates, but not the less valuable to the society on this account. They have already furnished us with specimens to return to Mr. Fabræus, in exchange for the insects received from him, and I have sent also a few of them to Mr. Schönherr for their names, and with the request that he would honor us with insects in exchange for them.

"There were several boxes and drawers in Mr. Hentz's collection very closely filled with insects of all orders promiscuously mixed together. These it was desirable should be assorted and incorporated with the others. In fact, it became absolutely necessary to select the Coleoptera without delay, to enable me to make a proper choice of specimens to be used in making exchanges. Accordingly, when obliged to suspend my labors on the cabinet of the society, for the want of drawers properly prepared to receive the insects, I began to assort the miscellaneous collection received from Mr. Hentz, and proceeded with all possible expedition until they were transferred from the boxes and drawers in which they came, to their proper places in the other part of the collection. *All the Coleoptera* received from this gentleman have been carefully examined, and are arranged in a regular series, according to the catalogue of Count Dejean. It will be comparatively an easy task hereafter to transfer these Coleoptera and unite them with the general collection of the society, should this be deemed advisable. I propose next, to arrange the insects of the other orders in a similar way."

6. *Conchology.*—Valuable accessions have been made during the past year, to our cabinet of shells. Several individuals have presented most acceptable donations.

Many specimens of foreign shells from Mr. Couthuoy—as uite of fresh water bivalves from the Ohio, from Dr. Ward of that state—and a large collection of East-India shells from J. J. Dixwell, Esq. are most worthy of notice.

These additions, however, are not all which have increased the value of the collection. Much labor and study have been devoted to their classification; and although containing at the present moment 153 genera, and 1700 species, the names of 1200 species have already been ascertained.

This is the largest public collection of shells in the Union, and adds more than any other department to the attraction of our museum.

7. *Zoophytes.*—Although no very great additions have been made to the collection of Zoophytes, we should not forget to mention a very beautiful foreign scutella, presented by Dr. T. W. Harris; a large mass of sponge attached to the madrepore, upon which it grew, from the Red Sea, presented by J. A. Lowell, Esq. and a valuable collection of corals from the East Indies, presented by J. B. Higginson, Esq.

The number of species now in our entire collection is as follows.

Mineralogy and Geology.—About seven hundred specimens.

Botany.—Several thousand species of plants, besides fruits, &c.

Zoology.—*Mammalia.*—Thirty whole skeletons; among these, those of the Simia satyrus, Cebus fatuellus, Hylobates fuscus, Erinaceus Europæus, Talpa Europæa, Elephas Indicus, Rhinoceros Indicus, Tapir Americanus, Hydrochœrus capybara, Cervus elaphus, Antilope dorcas, Didelphis Virginiana, Mustela lutreola, &c. &c. Thirty crania, some of which, are those of the Felis tigris, Sus scropha, Sus babirussa, Cervus Virginianus, Equus caballus, Mephitis putorius, Canis familiaris, Felis catus, Sciurus cinereus, &c. &c. besides many beautiful horns, and antlus; those of the Cervus alces, Cervus Canadensis, Antilope furcifer, Antilope rupicapra, Antilope strepsiceros, Antilope gazella, Antilope mhorr, Antilope gnu, Bos bubalus, var. Bos arni, should not be passed by unnoticed.

Birds.—Whole number mounted, fifty six. Several hundred, not mounted.

Reptiles.—Ninety genera—one hundred and thirty species.

Insects.—About fifteen thousand species.

Shells.—Upwards of seventeen hundred species.

Crustacea.—One hundred and thirty species.

Radiata.—One hundred and ninety species.

Library.—The Library contains about 600 volumes.

The most valuable additions which have been made to it the past year, are a memoir on the Nautilus pompilius, Audubon's Ornithological Biography and a set of the original plates to Abbott's birds of Georgia, from individual members; and the magnificent plates to Audubon's Ornithology, and the invaluable works of Olivier and Voet, presented by subscription. The former of these donations, are too well known to require a single remark; of the latter works, the curator of Entomology observes in his report upon Mr. Hentz's collection, of which they made a part, "it is hardly necessary to advert to the works of Olivier and Voet, which came with the insects. They are adorned with numerous plates, engraved by the best artists of the day and beautifully colored. The work of Olivier is in 10 volumes quarto, splendidly bound in calf and gilt; that of Voet in 4 vols. quarto, is in fancy boards, but the plates are even superior to those of Olivier's work. There is in the College library an imperfect and incomplete copy of Olivier's work, with uncolored plates, and in the library of the Academy of Natural Sciences of Philadelphia both of these works are to be found. These are, as far as I know, the only ones in the country—they are rarely to be obtained in Europe, and then only at a high price and some risk to the importer."

Communications.—Besides many verbal reports of great interest, twenty four written communications have been presented the last year by the following gentlemen, on the following subjects.

C. T. Adams.—The changes produced upon Mt. Holyoke by the effects of diluvial currents.

Amos Binney.—On several new species of shells in the cabinet of the society and on the Helices of the United States.

T. M. Brewer.—On the catologue of birds in Professor Hitchcock's Report, and a review of George Ord's paper in Loudon's Magazine of Nat. History, on the habits of the Cow-bunting.

J. P. Couthuoy.—Report upon a new shell from New Holland, a new species of Marginella, and a new species of Tritonia.

E. S. Dixwell.—Upon the luminosity of the sea.

A. A. Gould.—A report upon craw fish.

T. W. Harris.—On the Biche du mer, on the nest of the Placeus Phillipensies, and on the Meadow mouse.

C. T. Jackson.—Upon the coal mine at Mansfield: upon an analysis of three species of water from the Azores.

J. B. S. Jackson.—On the anatomy of the Testudo elephantopus, and on the anatomy of the genital organs of the horse.

D. H. Storer.—A report upon the Blennius physis, on a new species of Gasterosteus, on a new species of Marginella, and on a new species of Hydrargira.

Three years since, an effort was made to establish a journal containing papers upon Natural History read at the meetings of the society; and the first number was published. Its limited circulation rendered it inexpedient that the society should be longer responsible, and the expenses of the numbers published the two succeeding years, were liberally met by two of our members. It gives us great pleasure to add, that since the last annual meeting, a sufficient number of subscribers have been procured to meet the expenses of a *fourth*, which is now in course of publication; and that in future, our journal will appear more frequently.

The *committee of publication*, confidently look to the members generally, for countenance and support: they would use their utmost endeavors to make their publication alike creditable to the society and New England. While the societies of other cities in the Union are continually adding something new to the treasures of natural science, we should not be left in the course.

Mortifying indeed it is, to look over the catalogue of the natural history of our state, and not see a single bird, or fish, or reptile, or mollusk, associated with the name of an acting member of this society. *By others, they have all been made known. Much however remains undone.* Hundreds of our plants are unknown to naturalists:—the habits of many of our birds, and reptiles and fishes, are imperfectly understood: the list of our Crustacea and Radiata remains to be greatly enlarged; of the 2300 insects catalogued in Professor Hitchcock's report, *more than* 1100 *are new;* and by whom can they be better described, than by the *author* of that catalogue?

Disappointed in having no annual address, the gentleman who drafted the report the last year, added much to its value, by making an analysis of several of the written communications which had been read at the regular meetings of the society. Although many of the papers which have been presented since then, are of peculiar interest, and to offer the substance of which, would be most grateful to the feelings of your committee, he is reminded that by pursuing this course at the present moment, the report would encroach upon his time,* who is far better able to interest and instruct you, than he who has thus cursorily glanced at the progress of the society, since our last annual meeting.

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* Rev. Hubbard Winslow—the anniversary orator.

2. *Crosse's Galvanic Apparatus.**—The public attention having been much excited by the unpretending statements of Mr. Crosse at the late Bristol meeting, and with the remarkable effects produced by a galvanic apparatus the most extensive of any that has ever been erected, at least by a private individual, we doubt not that the following letter addressed to the editors of the London Mining Journal, by a gentleman so well known in science as the writer, (together with the article which immediately follows,) will be acceptable to the readers of our Journal.

TO THE EDITOR OF THE MINING JOURNAL.

Sir—Some questions having appeared in your recent numbers, concerning the construction of the galvanic apparatus of Mr. Crosse, I am happy in having it in my power, from having spent some interesting days in his house, to give your correspondents an account which I hope may prove satisfactory. I rejoice in the opportunity thus afforded me of showing, that although locally removed, I can never cease to feel a warm interest in what is passing in a county endeared to me by so many associations. Each separate combination, forming one of the members of Mr. Crosse's galvanic series, consisted of a plate of copper, containing from three to four square inches of surface, bent round so as to form a cylinder, inside of which was a similar plate of zinc; round the interior zinc cylinder a thin string was coiled spirally, to keep its surface, throughout, separate from that of the exterior copper cylinder—these metallic cylinders, were, in about a quarter of the series, placed in glass cylindrical vessels, just large enough to contain them, and filled with water; but, in the greater number, the external copper cylinder being soldered and closed at the bottom, so as to hold water itself, the glass containing vessel was dispensed with. When this was the case, the metallic cylinder was separated from the table on which the apparatus was placed, by the intervention of a small square of common glass, a little broader than the diameter of its base; this was done to secure the insulation. These cylinders were arranged into a series, in the usual form, by copper arches passing from the copper cylinder of each combination to the zinc cylinder of its neighbor. The apparatus when I saw it, just after the late Bristol meeting, was composed of eight hundred such cylinders, disposed in continuous lines, so arranged as to occupy the least room. Its effects, though excited with water only, were very powerful. I should say, equal to those ordinarily produced by about one third of the same number of galvanic combinations of equal surface, excited by acid—considerable lengths of thin wire were fused, &c. A common electrical battery of great size, containing seventy feet of coated surface, was charged in a single instant, if connected with the wires proceeding from the extremities of the galvanic series; and when successive discharges were, under these circumstances, taken from the electrical battery, the effects were most intense. After receiving three or four such discharges on the point of my pen knife I found, on examining it with a glass that its extremity had been completely fused. I need not dwell on the extreme importance of having constructed an apparatus capable of producing such powerful effects, when excited by water only; the excitation by acid is violent at first, but goes on rapidly decreasing, and at the end of three hours becomes almost null. If it were attempted to sustain an uniform action, by the continual affusion of fresh acid, the zinc plates would be entirely corroded in a very few days; indeed, the constant attendance necessary, and the enormous expense, would render such an attempt practically impossible. But in Mr. Crosse's apparatus, though excited by water only, we have a strength equal to very large ordinary troughs, say three hundred plates, and that strength is uniform and permanent, and requires no further attendance than replenishing the water, (from the loss sustained by evaporation,) once in six weeks; in this mode also, the corrosion is so slow, that the same apparatus might probably last for twenty years; much of it has already been in constant action much more than a year, and does not seem in the least impaired. The importance of imitating nature, by keeping in constant and uniform activity such powerful galvanic currents, must be obvious. Besides the series I have described, Mr. Crosse had begun to construct one of much larger dimensions; each cylinder containing a square foot in surface. Should he proceed with equal vigor we may expect some day to hear of two thousand of such cylinders; the effects must then be almost terrific. Could we, inquisitor-like, put nature to the question, by so efficient an instrument, she could hardly resist any interrogatories we might please to put to her, and all the mysteries which at present perplex us in chemistry might be expected to stand revealed. I should regard the completion of such an apparatus as quite a national object; and I feel convinced, that it is by proceeding in this line that we may best hope to see the force of electricity practically applied as a moving power, and the energy of lightning bent, like that of steam, into subserviency to the purposes of human art. I remain, Sir, your obedient servant,

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* From the Franklin Journal for April, 1837.

W. D. Conybeare.

3. *Accidental Production of Animal Life;* by Mr. Crosse.—A communication from Mr. Stutchbury, of the Bristol Institution, has been disseminated through the public journals, of which we give a copy. As there is no doubt of the honor and veracity of Mr. Stutchbury, the extract which this gentleman gives from a letter of Mr. Crosse, may be considered as if communicated by Mr. Crosse himself.

Sir—It may be truly said that facts recorded, faithfully detailed, and made public, are the means by which philosophy is enabled to render her temple more durable on its foundations—every additional fact being the commencement of that which, when understood, forms an outwork of defence, rendering the interior the strong hold and sacred depository of truth.

It was a maxim of the late John Hunter, which he was repeatedly proclaiming, that greater benefit would be conferred upon the community if professional men had the moral courage to publish detailed accounts of all their unsuccessful cases, than could be derived by the publication of those which met with a favorable termination, for then the physician would reject at once such as had failed as modes of cure, without repeating experiment after experiment, thereby saving much valuable time, and certainly sparing much needless pain to the unfortunate patient. So with facts in natural philosophy. Let experiments be recorded, and their results will enable others, either to avoid, or successfully to pursue them, so as to bring them to bear upon principles which may elucidate some great truth, the light of which would probably have never shone upon them, had they not been able to take advantage of the works of pioneers who had proceeded, perhaps, to the very threshhold of the same result.

With regard to a large number of curious and (at the same time, in consequence of the principle not being understood) astounding facts, the investigator would be doing a great injury in the cause in which he labors, should he be deterred from making them known, merely because he cannot at the same time reasonably account for the same. And upon this view of the subject, and to set at rest the vague views which are abroad, I feel it a duty due to the cause in which I am engaged, and to the philosopher with whom they have originated, at once to take the liberty of transmitting to the press, and particularly the local press, from which so many reports have emanated, an abstract of a letter I have received from Mr. Crosse, with an account of his experiments, in the language of a private communication, (not that which he would probably have chosen, had he made the communication himself,) and without further comment.

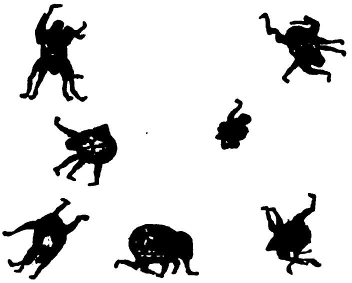
"The following is an accurate account of the experiments in which insects made their appearance:—

"*Experiment first.*—I took a dilute solution of silicate of potash, supersaturated with muriatic acid, and poured it into a quart basin, resting on a piece of mahogany; a Wedgwood funnel was placed in such a manner that a strip of flannel, wetted with the same, and acting as a siphon, conveyed the fluid, drop by drop, through the funnel upon a piece of somewhat porous Vesuvian red oxide of iron, which was thus kept constantly wetted by the solution, and across the surface of which, (by means of two platina wires connected with the opposite poles of a voltaic battery, consisting of nineteen pair of five-inch plates in cells filled with water and $\frac{1}{100}$ muriatic acid,) a constant electric current was passed. This was for the purpose of procuring crystals of silex. At the end of fourteen days I observed two or three very minute specks on the surface of the stone, white, and somewhat elevated. On the eighteenth day, fine filaments projected from each of these specks, or nipples, and the whole figure was increased in size. On the twenty-second day, each of these figures assumed a more definite form, still enlarging. On the twenty-sixth day, each assumed the form of a perfect insect, standing upright on four or five bristles which forms its tail. On the twenty-eighth day, each insect moved its legs, and in a day or two afterwards detached itself from the stone and moved at will. It so happened that the apparatus was placed fronting the south, but the window opposite was covered with a blind, as I found these little animals much disturbed when a ray of light fell on them; for out of about fifty which made their appearance at once, at least forty-five took up their habitation on the shaded side of the stone. I ought to have added, that when all the fluid, or nearly so, was drawn out of the basin, it was caught in a glass bottle, placed under a glass funnel which supported the stone, and was then returned into the basin without moving the stone. The whole was placed on a light frame made for the purpose. These insects have been seen by many of my friends, and appear, when magnified, very much like cheese-mites, but from twice to eight times the size, some with six legs, others with eight. They are covered with long bristles, and those at the tail, when highly magnified, are spiny. After they had been born some time they become amphibious, and I have seen them crawl about on a dry surface.

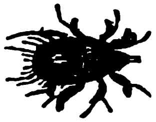
"*Experiment second.*—I took a saturated solution of silicate of potash, and filled a small glass jar with it, into which I plunged a stout iron wire, connected with the *positive* pole of a battery of twenty pair of cylinders, filled with water alone, and immersed in the same a small coil of silver wire, connected with the *negative* pole of the same battery. After some weeks' action, gelatinous silex surrounded the iron wire, and, after a longer period, the same substance filled up the coil of silver wire at the other pole, but in much less quantity. In the course of time one of these insects appeared in the silex at the negative pole, and there are at the present time not less than three well-formed precisely similar insects at the negative, and twelve at the positive pole, in all fifteen. Each of them is deeply imbedded in the gelatinous silex, the bristles of its tail alone projecting, and the average of them are from half to three quarters of an inch below the surface of the fluid.

"In this last experiment we have neither *acid*, nor *wood*, nor *flannel*, nor *volcanic iron-stone*. I will not say whether they would have been called to life without the electric agency or not. *I offer no opinion, but have merely stated certain facts.*"

In addition to this, on Friday, the 10th ult., Mr. Crosse transmitted to Mr. Owen, Hunterian Professor, College of Surgeons, London, a copy (pehaps the original) of the above, in his own hand-writing, with several specimens of the insects themselves, so enclosed in Canada balsam and between plates of glass and talc, as to be easily submitted to examination in the microscope. By the kindness of this gentleman, Mr. Clift, conservator of the museum, in the same establishment, produced them at the *Conversazione* of the Royal Institution on Friday, the 17th, when they were most satisfactorily visible in the microscope. By an extension of the same courtesy on the part of Mr. Owen, we have been permitted to draw and engrave two of the groups of these mysterious visitors, in order to gratify the prevailing intense desire for accurate information upon the subject.



The Insects magnified.



Cheese Mite, magnified to the same degree.

The insects above delineated are some of those collected and sent to London by Mr. Crosse. We have placed an ordinary cheese-mite near them, drawn to the same scale, in order to show the relative size, and the similarity of appearance. Like the mite, the new insects have fine hairs scantily distributed on the body, but these became invisible on the immersion of the insect in the balsam. Their varied positions, the arrangement of their legs, &c., are owing to their accidental suspension in the balsam, and the subsequent pressure of the plate of talc upon them.—*Mag. Pop. Sci.*

We cannot believe that life and organization have been produced by galvanic power, but would sooner suppose that the ova of the insects may have been contained in the materials galvanized or come into them during the process, and that the galvanic power may have quickened them into life, as electricity and animal warmth operate upon eggs.—Ed. Am. Jour.

4. *Fossil Remains of the Elephant,* Elephas primigeneus.—Every discovery of these fossils in our country deserves a distinct record by some responsible name. Some account of the following was published in the public papers, but I believe no notice of them is to be found in this Journal.

These fossil remains were dug up from a sand bank on the Irondiquot Creek in the town of Perinton, about ten miles east of this city.

They consist of a *tusk* and *two teeth* of the fossil elephant. The teeth are well preserved. The tusk had decayed for some distance at each end. As it lay in the sand, curved somewhat, it measured *ten* feet in length, and *seven feet* of it were removed, but a portion of this length broke into many pieces. The longest piece is *two feet* *and a half* long, and *five* inches in diameter, and as it belonged near the middle part of the tusk, the whole was of great size and near the root was probably eight inches in diameter. The large piece and many fragments are now in the possession of Mr. Butler, the enterprising proprietor of the museum in this city.

These fossils were found April 2d, 1833, in excavating the earth for the passage of water at a saw-mill. It is said that there were no indications of other bones or teeth. About *twenty* years before, a *thigh bone* of some huge animal was found in removing the earth a few rods below in the same bank. The whole probably belonged to the same animal, and more may yet be discovered on further removal of the earth. The *thigh bone* is said to be in the possession of a gentleman in an adjoining town to Perinton, but I have not been able to discover it. The tusk lay about *four feet* below the surface, and partly under the stump of a large forest tree. The place was covered with forest a few years ago; I have conversed with several individuals who were at the place, and knew the circumstances, and have examined the remains in the museum. There can be no doubt about the character of these remains and that they had been buried for centuries in the earth. The place is in the road, at the Irondiquot creek, a little distance from the place called *Fullum's Basin*, perhaps ten miles from Lake Ontario.

The *geological* relations of these fossils next merits attention. In this case there is no uncertainty. The Irondiquot creek is nearly on a level with Lake Ontario for four or five miles, and at this place, perhaps from the lake, is not more than fifty or eighty feet above it. The banks of the creek are *sand* thrown up into hillocks and sloping sides, from twenty to more than a hundred feet high; the sand being spread over a large extent of the country. The formation is evidently *diluvial*, resting on the *transition* rocks of this section. In various places the ground, coarse and fine, is mingled with this sand, and boulders of the primitive rocks brought from a region far at the north. On the surface we find the *erratic group*, in boulders of *granite*, *gneiss*, *mica slate*, *hornblende rock*, and *quartz*. These boulders are of various magnitudes. Some of them are large rocks, weighing many tons, and showing manifest evidences of the grinding power of sand and water, by which they were rounded. The Irondiquot runs nearly parallel to the Genesee, but is much lower, as the canal descends from the Genesee by several locks and then crosses the Irondiquot by the *great embankment of eighty feet* above the stream, only two miles south of the place where the bones were found. At this embankment, the sand is rolled up into still higher elevations than those already mentioned. Whenever the animal died, its bones seem to have been buried by that rushing of the waters, which accumulated these masses of sand, and left them as the miniature resemblance of the rolling waves of the mighty deep.

Rochester, N. Y., April 6th, 1837.

5. *Interlocking of Beech Trees.*—On the farm of Col. Geo. Warner in the southwest part of Stockbridge, Mass., is the following curious interlocking of two trees of the common *beech*, fagus *ferruginea.* They grew on the side of a hill near the bank of the Housatonic River, where the passage of the river around and through the north part of Monument Mt. presents very beautiful scenery. The right hand tree, *A*, as you stand facing the north, is nine and a half inches diameter at the base, while the left hand tree, *B*, which stood at the distance of eighteen inches from it and a little lower down the hill, is four and a half inches in diameter and shows *forty-four concentric layers.* The limbs of the trees are peculiarly zigzag or tortuous. At the height of ten feet from the ground, a limb from *B* has become so entangled in the limbs of *A*, that the body of *A* has grown entirely over the limb and so perfectly inclosed it that the limb appears to grow directly through it. The tree *A* is here five and a half inches in diameter, and the limb passes through it nearly in the middle from the center to the outside. The limb from *B* is two feet long to *A*, and one inch and a half in diameter where it enters *A*, but it is only one inch in diameter were it issues and then extends *ten feet.* The limb starts from *B*, about eleven feet from the ground. In the winter of 1836, the tree *B* was cut off for wood; but the farmer, finding it strongly entangled in the other tree and the weather being very cold, left it without ascertaining the reason of its being held so firmly by *A*. In the summer he saw that the tree, though cut off and having turned round from the weight above so as to have its lower end about three feet from the ground, was flourishing with rich foliage; he ascertained the singular union of the two trees, and called the attention of the curious to the fact. When I saw the trees in September last, they were covered with large, full, bright leaves, the one equally with the other so far as the eye could ascertain from laying the leaves side by side. The trunk of *B*, which was cut off, had healed over at the lower extremity so as to be green

with life quite to its end, and seemed to be as vigorous as the other. The trunk and limbs of *B* extend twenty feet beyond the limb which unites the two trees.

It is evident that it is the sap of *A*, which is elaborated in *B*, and is employed for its support. It is probable that the vessels in the part of the limb which unites the trees and in which the sap originally ascended are now used for the passage of the sap from *A* to *B*. In this case the vessels for the ascending sap perform their usual function through most of the uniting limb, and their action is inverted in the uniting part.

Rochester, N. Y., March 29, 1837.

6. *Rotting of timber in certain situations.*—Extract of a letter to the editor, from Mr. D. Tomlinson of Schenectady, N. Y., dated April 4, 1836.—In the year 1801, I built a ware-house on my lot in Union Street in Schenectady. The cellar was dug about four feet deep, and the stone wall a foot or two deeper. I left no opening in the walls for door or window. The floor beams were of excellent pitch pine timber of twelve by twelve inches, slit, and were six by twelve inches when placed in the wall, and about eighteen inches above the ground. I laid a floor of three inch oak plank, loose, neither jointed nor nailed, although they were square edge, and lay close to each other. Five years thereafter, I observed a jostling in a place in the floor, and raised one of the planks to learn the cause, and found one of the six by twelve inch beams rotted off and fallen on the bottom of the cellar. The plank was rotten below, except about an inch sound on the upper side. I lifted the whole floor, found most of the planks rotten, except a shell on the top; and the timbers were rotten, and so decayed, that I took them out and put in oak, after making windows and a door in opposite sides of the wall. I thought the depth of the cellar would have prevented injury to the timber, but found it the cause of the destruction, as fine shavings and slivers lying on the bottom of the cellar, were perfectly sound, while the timbers, were beautifully ornamented with curtains of white mold, hanging in festoons, nearly to the depth of the cellar, as white as snow, very thick, and appeared like bleached muslin.

In the year 1817, I took down an old kitchen on the same lot. The floor had lain on saplings of about 6 by 8 inches, such as are used for scaffold poles. They were bedded in the ground, so that the pine floor came next the ground, and excluded air. They had lain there from 1794, and both the timbers and flooring were very little injured by rot.

I concluded, that a free circulation of air must be allowed, or air must be entirely excluded, to save timber from decay.

It has been found, that when posts are set in the ground and cased with boards for better appearance, the confined air destroys them. Even red cedar, which lasts an age when set open, if cased, which is often done for ornament in gate posts, decays as soon as any other wood, by the confined air.

7. *The odor of wines, due to a peculiar ether.* By MM. J. LIEBIG AND PELOUZE. (Ann. de Ch. et de Phys. Oct. 1836.)—It is a fact of common observation, that a bottle containing but a few drops of wine, gives off a peculiar odor, which cannot be imitated by mixing alcohol and water in the proportions in which they exist in the wine. This characteristic odor, which is more or less apparent in all wines, is produced according to MM. Liebig and Pelouze, by a fluid possessing all the characters of an essential oil. The flower, aroma, or *bouquet of wine*, as it is more especially called, is produced by a substance which is inodorous, and should not be confounded with the subject of these remarks; it is not volatile, is different in the several kinds of wines, and in many fails entirely.

This oil may be obtained by distilling large quantities of wine, or the lees of wine, or especially from the product deposited after fermentation has commenced. From the results obtained they infer that this oil constitutes about $\frac{1}{40000}$ part of the wine. The oil as thus obtained, before purification, has a strong odor, and is generally colorless. Occasionally it presents a slightly greenish tint, derived from the presence of a small quantity of copper, as is proved by reagents; this color may be removed by distillation.

The constitution of this product, though it contains a considerable quantity of oxygen, is quite different from that of the oxygenated essential oils heretofore known. It proves to be a peculiar ether containing an acid allied to the fatty acids. This new acid is called by its discoverers, *œnanthic acid*, and the ether, consequently, *œnanthic ether*.

Œnanthic ether.—The œnanthic ether may be deprived of any free acid it may contain, by agitation with a hot solution of carbonate of soda, and subsequently boiling the mixture; the ether rises to the surface and may be readily removed. The small quantity of water or alcohol which it still retains, may be separated by means of the chlorid of calcium. The ether thus purified, is very fluid, similar to the essential oil of mustard. It is colorless, has an extremely strong odor of wine, which when respired is almost intoxicating. Its taste is very strong and disagreeable. It dissolves readily in ether and alcohol, even when the latter is quite dilute; yet it is not sensibly soluble in water. Its density is 0.862 and it is but slightly volatile. It boils between 225° and 230° C.

In three analyses, MM. Liebig and Pelouse obtained the following results,—

Carbon, . . .	71.815	72.50	72.02
Hydrogen, . .	11.844	11.86	12.05
Oxygen, . .	16.341	15.64	15.93

which correspond very nearly with the formula $C^{18}H^{36}O^{3}$. The œnanthic ether is readily decomposed by the caustic alkalies. With potassa, it affords a very soluble compound, consisting of œnanthic acid and potassa. When this salt is decomposed by sulphuric acid, the œnanthic acid forms an oily bed on the surface of the liquid.

Œnanthic acid.—This acid presents a butter-like consistence at a temperature of 13.2 C. and is of a white color; at a higher temperature it melts and forms a colorless, inodorous oil, which reddens turnsol and unites readily with the caustic alkalies and alkaline carbonates. The œnanthate of potash, is a pasty mass composed of extremely fine fibres, which present a silky lustre after desiccation. From the composition of the œnanthates of lead and silver, the authors infer that 2 atoms of base saturate 3 of acid.

In three analyses, MM. L. and P. obtained for the hydrated acid;

Carbon, . .	69.28	69.74	68.59
Hydrogen, . .	11.54	"	11.56
Oxygen, . .	19.18	"	19.85

which lead to the formula, $C^{14}H^{28}O^{3}$. The anhydrous acid afforded carbon 74.32, hydrogen 12.2, oxygen 13.58, which corresponds with the formula $C^{14}H^{26}O^{2}$. It may hence be inferred that œnanthic ether is composed of œnanthic acid united to common ether, as is represented in the formula $C^{14}H^{26}O^{2}+C^{4}H^{10}O$, in the construction of which and also in the preceding deductions, Berzelius's atomic weights have been used.

8. *Essential oil of potatoes*, by M. Augustus Cahours, (L'Institut, No. 199.)—According to Dumas, the essential oil of potatoes is represented by the formula, $C^{20}H^{24}O^{2}$. M. Cabours infers that this

oil is a compound analogous to alcohol and spirit of wood, in consisting of a peculiar compound of carbon and hydrogen for its base, ($C^{20}H^{20}$,) united to two atoms of water. He cites the following experiments by himself as proof of the correctness of this view.

The oil treated with sulphuric acid, and subjected to a mild heat, yielded an acid containing the same carburetted hydrogen for its base. This acid formed with bases soluble compounds, whose analogy with sulphovinates is incontestable. The salt of baryta, for example, contained $SO^3 Ba O + SO^3, C^{20}H^{20}, H^6O^3$. If the oil is put in contact with iodine and phosphorus, an ethereal substance is disengaged, giving off a slightly alliaceous odor, which is similar in composition to hydriodic ether. With nitric acid and chlorine, it afforded products of analogous constitution.

9. *Royal Geographical Society.*—At a late meeting of the Royal Geographical Society, there was read the following Memoir.—A Memoir on the province of Omán, on the East Coast of Arabia, by Lieut. J. R. Wellsted, Indian Navy, F. R. S.

The author of this highly interesting paper,—as indeed must be the description of a country into which, as the memoir states, "no European traveler has hitherto penetrated, and whose people and country remain wholly unknown to us,"—was selected by the government at Bombay to make a journey into the interior of Omán, and, with the usual spirit of liberality shown in the Indian service, was provided with instruments of all sorts for making scientific observations, with letters to the Imám of Muskat, who, as Mr. Wellsted states, "with his characteristic liberality, in every way forwarded my views, and gave me letters to the chiefs of all the districts through which I had to pass;"—and, in short, with every facility for this enterprising journey.

Quitting Bombay, Mr. Wellsted reached Muskat on the 21st November, 1835; this city has of late years been often described, but we may notice that our author states its population, including Mattrah, to be 60,000 persons, and its imports at 3½ millions of dollars. He thence went by sea to the port of Súr, about eighty miles to the southeast of Muskat, where he was civilly received by the Sheikh, and provided with guides and fourteen camels.

"*Dec.* 2. Leaving Súr," says Mr. Wellsted, "I journeyed along the Wadi Falij, twenty miles, in a southwest direction, towards the district of Jailan, thence S. S. W. twenty-two miles over a flat and uninteresting country, to the camp of the Beni Bú Ali Bedouins, in lat. 22° 3′ N. It was here that the detachment of troops under Captain Thomson, who, in the year 1820, in company with the army of the Imám of Muskat, had marched against this tribe, suffered so severely, and in consequence of which the following year Sir Lionel Smith was dispatched against them and destroyed them.* Since that time no European had visited this tribe, and I was not a little surprised at their truly kind and hospitable reception of me; every thing they could offer was at my service, and in speaking of the transaction of 1821, the wives of the Sheik said, 'We have fought—you have made us every compensation for those who fell, and we should now be friends.'

"*Dec.* 6. I continued my journey to the S. S. W., forty-five miles over the desert, and the following day the same distance W. S. W., to some wells, and thence returned to the tents of Beni Bú Ali.

"*Dec.* 10. Journeyed forty two miles in a north-westerly direction, through the shallow valley of Wadi Butha, as far as Bedia, a district comprising seven small oases, which are fertile and beautiful past expectation.

"*Dec.* 13. Over the same country to Ibrah, an old town containing several handsome houses, with a population of about 700 persons, and thence continuing by the same shallow valley to Semmed, in lat. 22° 50′ N., an extensive oasis, with about 800 inhabitants; in its vicinity is a large fort, garrisoned by the Imám's troops—hence, in a W. S. W. direction, to Minna, an old town in a fertile and rich oasis, open fields beautifully cultivated, groves of almond, citron, and orange trees, so luxuriant that we exclaimed with astonishment, 'Is this Arabia, that has been represented as a desert?' fields of corn and sugar cane extended for miles before us, streams of water flowing in all directions, and the cheerful and contented appearance of the Arabs proved that all was plenty.

"*Dec.* 23. I reached Neswah, in lat. 22° 50′ N., which is the largest and most populous of all the oases; here we left our camels and procured asses to ascend the rocky heights of Jebel Akdár, or Green Mountain, which here extends, in an east and west direction, a distance of more than thirty miles. I ascended the range, which is of limestone, and reaches 6000 feet above the sea, and passed some days on the high table land; the surface is bare, but the ravines well cultivated, and produce fruit and vegetables in abundance; the Beni-rehan tribe, which inhabit them, are not such fine-looking men as might be expected from their hardy life and mountainous abode, which may possibly be attributed to their immoderate use of wine, which, in spite of the precepts of the Koran, they indulge in, and excuse it on account of the cold they are exposed to; the wine resembles that from Shiráz. On my return to Neswah I made various short excursions into the desert to the southwest.

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* See Fraser's Journey to Khorasan, Appendix A.

"*Jan.* 15. Owing to the malaria arising from a rank vegetation in an oasis at Neswah, I was seized with a fever, became delirious, and suffered severely; on regaining my senses, I was so weak that it was requisite to go to the sea coast for change of air, and therefore went to Síb, twenty miles N. W of Muskat, which is celebrated for its salubrity, and here remained till the end of February. I then started again along the coast, as far as Suìk, sixty miles farther to N. W., whence I turned into the interior of the country in a S. W. direction, till we reached Makinyat on the 10th of March; this was once a large town, but now is nothing more than a straggling village, never having recovered from a visit made to it in 1800 by the Wahabis—it stands in 23° 21′ north latitude, forty two miles from the nearest point of the coast at Khobúr. We hence continued in a W. N. W. direction, over a succession of barren and sandy plains to Obri, where, to our annoyance, we found 2000 Wahabís had taken possession of it; they were proceeding to attack Bedía, and when they found we were traveling under the Imám's protection, it was with some difficulty I escaped from them without being pillaged or murdered. I was therefore obliged to retrace my steps to Suík, on the coast, and went by sea to Shinás, in hopes of reaching Brémah, but in vain. The province of Omán extends about three hundred and fifty miles from Cape Musseldom on the north, to the island of Mazeira on the south, with an average breadth of one hundred and twenty miles, yet this seems very ill defined; it is divided into four districts, namely, 1. Batnah, extending in a narrow strip along the coast, from the northward, as far as Síb; 2. Darrah, parallel to the former, but in the interior; 3. Omán, comprising the central parts, and Muskat; 4. Jalian to the southeast.

"It may be described as a desert, thickly studded with oases, and containing amidst its mountains many fertile valleys, yet the cultivated parts bear but a small proportion to that which is barren.

"The average height of the range of mountains which runs throughout the extent of this part of Arabia is from 3000 to 3500 feet; yet the highest points of Jebel Akdár exceed 6000 feet above the sea; the width of the range is from twelve to fifteen miles; feldspar and mica slate enter most commonly into the formation of the lower ranges, and limestone the upper; with the exception of Jebul Akdár, they are devoid of wood, and barren."

The interest of this memoir was very much heightened by the exhibition of a beautiful map, showing the traveler's route throughout a distance of seven hundred miles by land, and, by the various explanations and illustrations given by Mr. Wellsted, who was present during the reading of this narrative, which is a most valuable addition to the geography of the hitherto unexplored country of Arabia.—*Athenæum, April,* 1837.

10. *Meteorological Tables for the year* 1836,* *prepared by the Meteorological Department of the St. Louis Association of Natural Sciences.*

TABLE I.—*Showing the temperature in* 1836, *compared with the average mean temperature of seven years.*

Months.	1836. Maximum.	1836. Minimum.	1836. Range.	1836. Mean.	Average mean temperature of seven years.
January,	50.0	0.5	49.5	30.9	29.5
February,	68.0	8.5	76.5	32.5	34.5
March,	70.2	7.2	63.0	38.3	42.7
April,	89.4	28.6	60.8	58.5	58.6
May,	97.2	47.7	49.5	68.9	65.2
June,	99.5	56.7	42.8	74.5	73.1
July,	98.4	61.2	37.2	78.6	78.1
August,	93.9	52.2	41.7	73.6	74.6
September,	92.7	45.5	47.2	67.8	66.9
October,	87.1	24.1	63.0	48.4	55.8
November,	70.2	16.2	54.0	40.8	49.2
December,	53.2	1.7	54.0	29.9	33.7
Whole year,	99.5	8.5	108.0	53.5	55.2

TABLE II.—*Showing the state of the weather and prevailing winds in* 1836, *compared with an average of four years.*

Months.	Dry days. Clear.	Dry days. Change.	Dry days. Cloudy.	Wet days. Rainy.	Wet days. Snowy.	Sunshine.	No sunshine.	Thunder storms.	Winds.
January,	9	9	4	7	2	19	12	—	S. E.—W.—N. W.
February,	5	11	1	6	6	23	6	1	N. W.—S. E.—S. W.
March,	15	8	1	5	2	27	4	2	N. W.—S. E.
April,	9	11	1	9	—	28	2	10	N. E.—S. E.
May,	10	11	—	10	—	28	3	7	S. E.
June,	3	18	—	9	—	29	1	2	S. E.—N. W.
July,	7	17	—	7	—	30	1	7	S. E.—N. W.
August,	5	14	—	12	—	28	3	5	N. W.—S. E.
September,	10	8	—	12	—	27	3	6	N. W.—S. E.
October,	12	10	—	9	—	27	4	3	N. E.—N. W.
November,	14	6	1	7	2	24	6	1	S. E.—S. W.
December,	14	7	—	6	4	25	6	2	S. E.—S. W.—N. W.
Whole year,	113	130	8	99	16	815	51	46	S. E.—N. W.
	251			115		—	—	—	
Average of four years.	138	109	13	92	13				
	260			105		314	51	53	

An aurora borealis was seen Oct. 12th, at 2 A. M.

These tables are the result of observations made three times daily, viz. at sunrise, at 2 o'clock, P. M. and at 9 o'clock, P. M. The thermometer from which they were taken was kept at the north side of a house, where it was never exposed to the rays of the sun, and where the northern and western winds had constant access. The instrument was elevated sixteen feet above the ground, and fifty above the level of the Mississippi river.

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* A continuation of these notices will be acceptable.—ED.

11. *A System of Mineralogy: including an extended Treatise on Crystallography: with an Appendix, containing the application of Mathematics to crystallographic investigation, and a Mineralogical Bibliography. With 250 wood cuts and four copperplates, containing* 150 *additional figures.* By James Dwight Dana, A. M. Assistant in the department of Chemistry, Mineralogy and Geology in Yale College; member of the Yale Nat. Hist. Soc., and of various other scientific societies. "*Hæc studia nobiscum peregrinantur, rusticantur.*" New Haven: Published by Durrie & Peck, and Herrick & Noyes, 1837, large 8vo. pp. xiv and 580.

We consider this volume a very important accession to our mineralogical literature, and one which we are sure will be gladly welcomed by every lover of science. A work of this extent and value has just claims upon us for a notice of its distinctive features and some general account of its contents.

The body of the work consists of six distinct parts, viz.

Part 1. Crystallology, or the science of the structure of minerals, p. 5–68.
2. Physical properties of minerals, p. 71–86.
3. Chemical properties of minerals, p. 87–90.
4. Taxonomy, or principles of classification and nomenclature, p. 92–103.
5. Determinative mineralogy, p. 105–148.*
6. Descriptive mineralogy, p. 145–445.

In Part I, we have, after the usual preliminary definitions, a comparative view of the primary forms, accompanied by an analytical table which shows at a glance their mutual affinities and dependencies; after which are descriptions of the primaries and the particulars of their mutual relations, with illustrative figures so arranged as to exhibit the transition of one form into another. Next follow remarks on the crystallographic axes of crystals, and a classification thence resulting of these forms into what are termed *Systems of Crystallization*, which are seven in number. This mode of grouping the primary forms is, to use the words of Whewell, "so scientific and yet so simple, that it is irresistibly superseding the older Haüyian arrangement, and the more so, as it is strikingly confirmed by the optical properties of crystals." The practical value of this classification is apparent in the first Analytical Table given by the author for the determination of species, inasmuch as we may often decide to which of these systems a mineral under examination pertains, without being able to determine what is the particular primary form. To these systems of crystallization, the author has applied the following nomenclature, partly derived from other authors and in part original; viz. the *Monometric*, including the cube, regular octahedron and rhombic dodecahedron;—*Dimetric*, the right square prism and square octahedron;—*Trimetric*, the right rectangular and rhombic prisms, the rectangular and rhombic octahedrons;—*Tetraxonal*, the rhombohedron and hexagonal prism;—*Monoclinate*, the right rhomboidal and oblique rhombic prisms;—*Diclinate*, the oblique rectangular prism;—*Triclinate*, the oblique rhomboidal prism. The laws for the occurrence of secondary planes are explained with much particularity and illustrated by an extensive series of figures. Next follow remarks on the lettering of figures of crystals and an explanation of the system adopted by the author, which every one will see, is vastly preferable to the method (if it deserves the name,) which now prevails. We have no room to state it, but we can confidently say that its general adoption would save the student much perplexity, (since a mere inspection of a figure thus lettered, informs him on what edges or angles the secondary planes there given are situated,) and would also greatly facilitate the comparison of different figures. The chapter on the means of detecting the primary forms of crystals, by goniometrical measurements, observation of cleavage, situation of secondary planes, &c. is quite extensive and satisfactory. It is followed by one treating of compound crystals and of aggregations of imperfect crystals.

We now come to the section on Theoretical Crystallogeny, in which, after a brief history of the science, the author unfolds his own original views of the ultimate structure of crystals. These were first made public in the thirtieth volume of this Journal. After much examination of this matter, we do not hesitate to declare our opinion that this mysterious problem, which since the days of Epicurus, has been so often unsuccessfully attacked, is at length here solved. Many facts which at first seem to be exceptions to the universality of the laws which this discovery develops, are shown to be its legitimate and even necessary results; and many curious phenomena which no other theory can interpret, are by this beautifully explained. Enough is already known to ensure the stability of this new theory; the progress of discovery, will, we are sure, only contribute new confirmation of its truth. A brief chapter on Practical Crystallogeny concludes this Part.

Part II, treats of the Physical characters of minerals, or those depending on light, electricity, magnetism and specific gravity; also of the hardness, state of aggregation, kinds of fracture, and odor.

Part III, consists mainly of directions for the use of acids and of the blowpipe.

Part IV, treats of the classification and nomenclature of minerals, and discusses the relative importance of crystallographic, physical and chemical characters in determining identity. The author here brings forward the classes and orders of his natural classification, the genera and species of which are given in Part VI. The classes, and in general the orders, are similar in their characters to those of Mohs. The following is the statement of its grand divisions.

Class I, Epigæa, (containing two orders) includes the gases, unmetallic liquids and soluble minerals. They have in general resulted from the decomposition of other species and are consequently epigæan or superterraneous. Their specific gravity is below 3·8.

Class II, Entogæa (twelve orders) comprises those insoluble minerals which occur in or compose the several rock strata, and which are therefore appropriately described as occurring *within* (ἐντος) the earth. Specific gravity above 1·8.

Class III, Hypogæa, (two orders) contains those species that are literally hypogæan, or have resulted from the inhumation of vegetable or animal matter. Spec. grav. above 1·8.

Part V, contains two new tabular classifications the object of which is to enable the unaided student to arrive at the names of minerals. The first includes all crystallized minerals and is arranged according to the systems of crystallization before mentioned. These classes (with the exception of the class Triclinata) are each divided into two sections, according to their *unmetallic* or *metallic* lustre. The individuals in these sections are arranged in the order of their hardness, under the heads of *hardness*, *gravity*, *cleavage*, *lustre*, *color*, *diaphaneity*, &c. The second table is independent of crystallization, and is distributed into the three grand classes before named, subdivided into sections and subsections depending (with the exception of the individuals of Class I,) on their metallic or unmetallic lustre and their colored or uncolored streak. The species in these several subdivisions are arranged in the order of their hardness, under the heads of *hardness*, *gravity*, *structure*, (including references to the system of crystallization,) *lustre*, *color*, *diaphaneity*, *effects of acids and of the blowpipe*. The minerals in several of the sections are moreover again arranged according to their specific gravity. The manner of using these tables is next explained. They cannot fail to be of great utility. We have no where seen given any method by the use of which the student can so surely and so readily arrive at the names of minerals.

Part VI, opens with the catalogue in full, of the classes, orders, genera and species of the mineral kingdom, arranged according to their natural affinities; the nomenclature being in the Latin tongue, in conformity with the practice in other departments. This reformation of the nomenclature of Mineralogy, is by no means the smallest merit of the peculiarities of this work. Hitherto, since the abandonment of the systems of some of the successors of Linnæus, this part of science has been "a jumble of terms derived from almost every language, whether dead or living, and almost every system, founded upon no common principle, and equally destitute of precision and simplicity." The Latin is the only tongue in which the names of minerals can constitute a common language throughout the civilized world; and the mode of denominating the species by a binary name, which has so long been advantageously employed in zoology and botany, will doubtless be found equally useful in mineralogy. The construction of so many new words was certainly a work of difficulty, yet the task has been very successfully performed. We think that among these names, there will be found less to offend the ear and to embarrass the organs of utterance, than in an equal number taken at random from any book of descriptive botany or zoology.

The descriptions of species are next given, and occupy nearly three hundred pages. They are succinct and methodical, and in most cases illustrated by figures of the more common secondary forms. To the descriptions are added the composition, economical uses, and localities, together with any other particulars of interest. Accompanying the trivial names, are copious catalogues of synonyms, which are rendered available to the inquirer, by being registered in the index.

We pass now to Appendix A, (occupying 80 pages,) which is a very important portion of the work, and one of its chief peculiarities. It is entirely occupied with a treatise on the application of mathematical calculation to crystallographic investigation. This portion is the more worthy of attention, since nothing on the subject has ever been published in this country. Its character is sufficiently stated when we say that it is a judicious abstract of NAUMANN's unrivalled work on

Crystallography. The means of calculation employed by that distinguished author, are those furnished by Geometrical Analysis, of which he says, "it is and must be the simplest and most natural of all methods." The practical value of these calculations, appears from the following remarks of the author:—"the determination of a single angle in a dimetric or tetraxonal solid, is, in some instances, sufficient for ascertaining every angle, interfacial or plane, that the solid contains, and often in the monometric solids not even this datum is required."

Appendix B, is occupied with a discussion of the chemical classification of minerals, and a tabular view of the same.

The work is concluded by a Mineralogical Bibliography, of seventeen pages, containing 1st, a catalogue of all the ancient works on this science, with a selection of the most important ones of modern times, and 2d, a catalogue of all American publications on mineralogy, both original and reprinted, and likewise a list of all the articles on this topic, scattered through the American periodicals. Catalogues of this nature have always been held valuable. They furnish information which few have the opportunities of collecting, and are of the utmost importance to those who make original investigations. We here see how little this nation has, until recently, done for the advancement of a science, a knowledge of which is so important to the full development of the resources of the country. This cause of reproach is now however fast disappearing. The institution of geological and mineralogical surveys in most of the states, does great honor to our legislators, and must contribute much to extend the boundaries of science. Many minerals now unknown, are doubtless reserved to reward the search of future explorers. Within a short space of time and a limited extent of territory, three new species (viz. Microlite, Edwardsite, and Eremite) have been added to the domain of Mineralogy, by one of the most zealous and accomplished cultivators of this science among us. We trust that many in other parts of the land will imitate his zeal and be alike successful.

The mechanical execution of the book merits commendation. The figures both on wood and copper are made with much neatness and accuracy, and the printers have evidently spared no pains in contributing their part towards the execution of a text book, superior in typographical excellence to any of its American predecessors.

The industry, research and scientific attainments evinced in the execution of this work, afford satisfactory evidence of the ability of the writer, and give a pledge of future equally successful labors in the same field. On the whole, we believe this to be decidedly among the best treatises upon this subject that have ever been circulated in the United States, and we are of the opinion that even a slight examination of it, will be sufficient to commend it to the favor of every cultivator and lover of Mineralogy.—*Communicated.* T.

12. *Transactions of the Natural History Society of Hartford, Conn.* No. 1, Vol. I. Hartford, Connecticut, 1836.—This is the first scientific publication of this recently organized body. Sixty four pages are occupied by an address from the Rev. Dr. Jarvis, of Washington College, President of the Society, on the rise and progress of Natural History. This sketch is graphic, lucid and as comprehensive as the limited space would allow; occasionally it is eloquent, and his appeal to his fellow citizens on behalf of the Society, is peculiarly appropriate and cogent. He gives also a short outline of the progress of Natural Science in this country; as full, perhaps, as an impartial review of living men would allow. The remainder of the number is occupied by an entomological article, entitled, *Characteristics of some previously described North American Coleopterous Insects, and descriptions of others which appear to be new in the collection of Mr. Abraham Halsey: by T. W. Harris, M. D., Librarian of Harvard University. Communicated Dec.* 23, 1835.

This number is very creditable to the society, and we sincerely hope they will meet with every encouragement necessary to the successful prosecution of the object of their organization.

13. *Meteors at Hingham.*

Hingham, Mass., (near Boston,) March 12, 1837.

To Professor Silliman.—*Dear Sir*—Having observed in the last number of the "American Journal of Science," &c. several accounts of the meteoric shower on the morning of 13th Nov. 1836, and deeming it a service to science to record every circumstance, which may serve to advance its interest, I forward to you my own experience.

Rising at an early hour, my attention was attracted to the subject, by the flight of a very large luminous meteor, which passed towards the west. This occurred at half past four. It seemed to be very low and greatly resembled a sky rocket, leaving behind a train of sparks, such as usually accompanies these artificial pyrotechnics.

From this hour, until daybreak, seventeen others fell, all of which, with a single exception, were small, many faint, and of the appearance of "shooting stars" as they are generally termed, such as are seen on any clear evening. The other was large and brilliant, resembling the one first mentioned, but appeared at a greater height, though accompanied by a beautiful train of sparks. These seventeen seemed to fall towards the southeast and southwest. Three flashes of lightning were distinctly visible at distant intervals of time, on the very edge of the southern horizon. A stratum of faint clouds, like mist, overhung that portion of the horizon, unlike the cloud which always accompanies the aurora borealis. The rest of the sky was clear and bright and the atmosphere delightfully serene. Although in all, there were but eighteen meteoric bodies, yet the circumstances and time seemed clearly to denote the mysterious return of that gorgeous shower which attracted such universal attention.

You will observe that the space of time was from half past four o'clock to daybreak, about two hours. Perhaps the phenomenon I had the pleasure of witnessing was only the conclusion of a greater display. With sentiments of respect, yours, &c.

JOHN LEWIS RUSSEL.

14. *Auroral Appearance.**—A a quarter past nine o'clock on Sunday night the eighth day of May, in the present year, my attention whilst regarding the heavens was forcibly attracted to the sudden appearance due east of a shining broad column of light.

At first, as my window overlooks the bay of Toronto and the low island which separates it from the lake, I took this singular pillar of light for the reflection from some steamboat on the clouds, but having sought the open air on the gallery which commands a full view of the bay and of Ontario, I was convinced that the meteor was an effluence of the sky, as I now saw it extend upwards from the eastern water horizon line to the zenith, in a well defined, equal, broad column of white strong light, resembling in some degree that of the aurora, but of a steady brightness and unchanging body, whilst there were few or no clouds. Ursa Major, then near the zenith, was situated with regard to this column, at a quarter past nine as below, the column passing nearly vertically between ζ and η.

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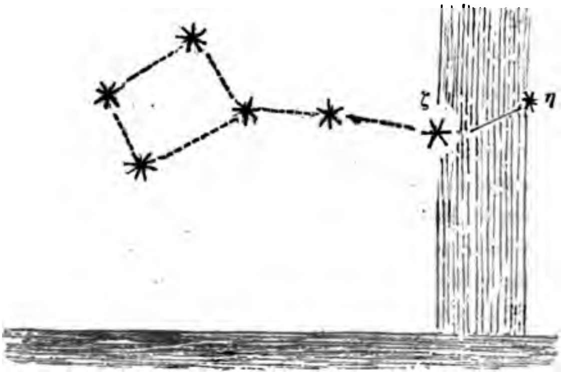
* Toronto, Upper Canada, Dec. 3d, 1836.

To Professor Silliman.—As every thing relating to meteorology is of importance and should be recorded, I have sought amongst my papers, for some notices of a singular appearance in the sky on Sunday evening the eighth of May, 1836, which I had overlooked, but which I now think it right to communicate to your valuable Journal, wherein I perceive the subject of auroral phenomena has latterly been much discussed. I have been led to seek more after opportunities of witnessing and recording these appearances in the heavens, from having read the "Observations on solar and lunar columns, halos, the aurora and auroral clouds," by Professor Joslin, of Union College, State of New York, whom I beg to thank for his politeness in sending me his work. Very sincerely, yours,

R. H. BONNYCASTLE.

Zenith.



Horizon line of Lake.

There was no moon, as on that day it rose at 2*h*. 4*m*. consequently it was dark, and as the sky was not very cloudy the meteor was seen to the greatest advantage as the night wore on. It passed very slowly and bodily to the westward, continuing to occupy the space from the horizon to the zenith, until the upper part first faded slowly and then the whole gradually disappeared, after it had reached nearly to due northeast. I had unfortunately broken my thermometer and could therefore only state that the weather was cold, and that there was no wind. At twenty five minutes past nine o'clock the pillar of light had vanished, but it immediately afterwards reappeared slightly in the horizon where it had been last seen, and in the mean time the constant auroral arch of the halos I have before mentioned, in Vol. 30. p. 131, became visible in the northern horizon, and increased very rapidly in brilliancy, and at ten minutes to ten gave so intense a glow to the sky that it was light enough to enable me to see the objects around distinctly as in pale moonlight. It was in short equal to the light of the moon at the end of the second quarter.

The auroral arch rose very high on this occasion and then flattened, and at ten the double arch, I have already described, was peculiarly beautiful, the darkness under it being singularly grand.

I thought it better, although nothing scientific, as there are no instrumental details in this slight notice, not to lose it altogether and therefore send it to you as it is, with "all its imperfections on its head," as from a variety of even such slight and informal observations there would be "much matter to be learned," particularly as I do not consider the almost stationary column of white light first appearing in the east, before the aurora began, as being of an auroral character, its motion, its peculiar wild and steady lustre and the uniform breadth which it preserved from the horizon to the zenith, distinguishing it from the fanciful and shooting flashes of the auroral columns.

15. *Meteorite.*—A notice in the Boston Daily Advertiser of June 10, 1837, states that a meteoric stone is reported to have fallen between three and four P. M. May 5, at East Bridgewater, (Mass.) The only witness was a lad of 15 years of age, who was alarmed by what he supposed to be a stroke of lightning in a neighboring field. Being at play with considerable noise, he did not observe any report, but thought there was scintillation and that the meteor might have burst before it reached the earth, which is said to have been somewhat torn up, and several pieces of the stone were found yet sensibly warm, and were seen and examined by several persons. Nine pieces of the stone were obtained, weighing in the whole half a pound, and the largest piece a quarter of a pound; four other pieces were afterwards found in such a position as to indicate that they may have been separated before the meteor reached the ground.

The whole stone appears vitrified as if from rapid cooling. The outside is black, glazed and shining, but within it is gray and full of oval shaped cavities. It is attracted by the magnet and resembles the lava or the scoria of a furnace, which latter substance the writer of the notice would have taken it for, had it not been reported to be warm when taken up. The sp. gr. of four fragments weighing respectively 85.50, 73.52, 43.30, and 28.75 grains, was found to be 2.611, 2.083, 1.728, and 2.815, mean 2.159.

We have thought it right to preserve this notice, although we have not seen any specimen of the stone. The specific gravity being less than that of common stones, and not much more than half of the usual weight of meteorites, while the substance is still attractable by the magnet, must of course imply a considerable degree of inflation and of course a violent and legible effect of heat.—*Ed. Am. Jour.*

16. *Aurora Borealis of February* 18, 1837.—A very beautiful display of Northern Lights was witnessed on the night of the 18th February last, at London, Belfast, Paris, Göttingen and many other places in Europe. At Göttingen it was visible from 7 P. M till 2 A. M of 19th inst., and according to the observations of GOLDSCHMIDT,* produced a very sensible disturbance of the magnetic needle. The range of the needle's variation was about 20′, and its movements rapid.

It is an interesting fact, that on this same evening the Aurora Borealis was visible at this place, (distant 83° of long. from Göttingen,) and that its effect on the magnetic needle here was very manifest. Soon after sunset, the east to the altitude of 40° was tinged with a faint purple color, and from the end of twilight until about 9 P. M, a broad indefinitely-bounded zone of a dim red, spanned the heavens from east to west. It was however too indistinct to attract much attention. At 9*h*. 15*m*. P. M. mean time, a region about 10° wide and 15° high, (having its center at N. 30° E.,) was lighted up with a beautiful rose-red. Without any perceptible change of position, this illuminated region was visible till 11 P. M., (when the observations ceased,) often varying in intensity from a deep rose-red to a faint and scarcely appreciable stain. During this time, no auroral light was seen in any other part of the sky. The needles of a Variation Transit and of a theodolite were first inspected at 9*h*. 20*m*. and the north end of each was then found about 15′ east of its usual position at this hour. At 9*h*. 22*m*. the variation reached its maximum, viz. 35′ east of the mean.† From this period until 11 P. M., the needle moved back and forth, at times with considerable rapidity, and almost wholly on the eastern side of its mean direction. The times above given are uncertain within three minutes.

New Haven, Conn. E. C. H.

17. *The Production of Galvanic Music.*—The following experiment was communicated by Dr. C. G. Page of Salem, Mass., in a recent letter to the editor. From the well known action upon masses of matter, when one of those masses is a magnet, and the other some conducting substance, transmitting a galvanic current, it might have been safely inferred (a priori,) that if this action were prevented by having both bodies permanently fixed, a molecular derangement would occur, whenever such a reciprocal action should be estab-

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[*] L'Institut, April 5, 1837.

[†] N. 5° 55′ W.

lished or destroyed. This condition is fully proved by the following singular experiment. A long copper wire covered with cotton was wound tightly into a flat spiral. After making forty turns, the whole was firmly fixed by a smearing of common cement, and mounted vertically between two upright supports. The ends of the wire were then brought down into mercury cups, which were connected by copper wires with the cups on the battery, which was a single pair of zinc and lead plates, excited by sulphate of copper. When one of the connecting wires was lifted from its cup a bright spark and loud snap were produced. When one or both poles of a large horse shoe magnet, are brought by the side or put astride the spiral, but not touching it, a distinct ringing is heard in the magnet, as often as the battery connexion with the spiral is made or broken by one of the wires. Thinking that the ringing sound might be produced by agitation or reverberation from the snap, I had the battery contact broken in a cup, at considerable distance from the field of experiment; the effect was the same as before. The ringing is heard both when the contact is made and broken; when the contact is made, the sound emitted is very feeble; when broken it may be heard at two or three feet distance. The experiment will hardly succeed with small magnets. The first used in the experiment, consisted of three horse shoes, supporting ten pounds. The next one tried was composed of six magnets, supporting fifteen pounds by the armature. The third supported two pounds. In each of these trials the sounds produced differed from each other, and were the notes or pitches peculiar to the several magnets. If a large magnet supported by the bend be struck with the knuckle, it gives a musical note; if it be slightly tapped with the finger nail, it returns two sounds, one, its proper musical pitch, and another an octave above this, which last is the note given in the experiment.

18. *The American edition of Dr. Buckland's late Work on Geology and Mineralogy, considered with reference to Natural Theology.* Carey, Lea & Blanchard, 2 vols. 8vo. Phil.

We are happy to see this admirable work laid before the American public. We have already recorded our favorable opinion of it, and a reiterated perusal and study only confirm the conviction of its high claims to the attention of the scientific and religious world. Both its physical and moral demonstrations are of the highest order, and it has settled forever (if it had not been settled before,) the great antiquity of our planet and the wisdom of the arrangement, which made it necessary that ages should elapse, in order to prepare it for its grand object the reception of man.

The consistency of all these things with the Genesis, is ably illustrated by Dr. Buckland, in a preliminary discourse, and we are fully convinced that nothing is necessary to a universal and just conviction on that subject, but *a full knowledge of the facts, without which it is impossible to judge in the case.*

In this American edition, all Dr. Buckland's admirable graphic illustrations are preserved and beautifully executed.

This work is very appropriate to the library of clergymen, and we hope it will be not only read but studied by all who feel an interest (as all ought to feel,) in the great questions about which it is conversant.

19. *Incidents of Travel in Egypt, Arabia Petræa and the Holy Land;* by an American, with a map and engravings, in 2 vols. 12mo.

We have derived much instruction and pleasure from a perusal of this work of Mr. Stevens. It is replete with valuable and interesting information on Egypt, Arabia, Idumea and Palestine, countries which both sacred and profane history have, for ages, commended to our deep regard and profound veneration.

The author is a man of quick and accurate perceptions; he conveys his impressions with great energy, eloquence and beauty, and with a peculiarly happy and graphic tact, he hits off every subject, with sketches so strong and vivid, that the scene whether grave or ludicrous, is placed fully in our view.

One who has mounted the pyramids of Egypt, explored her tombs and her immense ruins, ascended one thousand miles to the cataracts of the Nile, conversed with the Pacha, crossed the Red sea where the Israelites did, climbed mount Sinai and mount Hor, who has surveyed the colossal remains of the long lost city of Petra, the capital of Edom or Idumea, floated on the waters of the Dead sea, as a bath, and domesticated himself among the holy places of the Holy city—such a man will *command* our attention, and we hazard nothing in saying, that no one who begins to read Mr. Stevens' volumes will willingly lay them down until the perusal is finished. This work is a happy sequel or companion to that of the Rev. George Jones, and like that will add, if possible, to the confidence and veneration with which the early bible history is justly regarded.

20. *Earthquake.*—An earthquake occurred at Hartford, Conn. on the 12th of April, 1837. It was very slight, yet sufficient to jar all loose articles and swing the pendant lamps; in one house a bell was made to ring, and some of the inhabitants in that part of the town called Wethersfield lane, ran out of their houses, thinking they were about to fall.

21. *Edmonson's Revolving Magnet.*—In the notice published in our last No. of the revolving electro-magnetic machine of Mr. Davenport, we forgot to mention that of Mr. Edmonson, of Baltimore, which was figured and described in Vol. 26, at p. 205, of this work, to which the reader is referred.

22. *Electro-magnetic Machine of Davenport & Cook.*—We are informed that they have constructed a seven inch wheel, with two tiers of magnets in the revolving part, or four crosses, which will be applied to a turning lathe, and will raise over one hundred lbs. from the floor. They find sulphate of copper forms the best excitant for the battery, with which the machine will run a long time, without exposing the battery to the atmosphere, or heating the same too much.

We have not received any drawings or other illustrations, regarding this machine, as was intimated in the report in our last number, that we might now present to our readers. We understand the proprietors are not yet ready.

23. *Geological Survey of Connecticut.*—The Report of Prof. Shepard on the Economical and Scientific Mineralogy of the State, is now in press in this city, and will shortly be published in accordance with the resolution of the General Assembly at its recent session in Hartford. The publication of the Geological Report is deferred until another year, in order to enable Dr. Percival, the commissioner to whom this part of the survey was entrusted, to complete the necessary examinations.

24. *Asia Minor.*—M. Texier, in his summary account of the geological construction of Asia Minor, describes the Black Sea, of which it has hitherto been supposed that, in consequence of some violent shock, its waters opened a passage for themselves, and in so doing caused the deluge of Samothracia; but on examining the two sides of the Bosphorus, M. Texier says, they are of such different

strata, that they never can have been united. The European side is composed entirely of trachyte and analogous rocks, and the Asiatic of transition limestone. The trachytes have a blue ground with white crystals, and extend in width of several leagues as far as Belgrade and Kila. If the Bosphorus diminish, as reported, it is probably owing to the effusion of the trachytic rocks on the European side.—*Athenæum*, *May*, 1837.

25. *Silex.*—M. Turpin has submitted the silex sent from Berlin by M. Ehrenberg, to microscopic observation. The magnifying power amounted to 260, and this gentleman found, that the semi-opal of Berlin is a conglomerate of a number of siliceous particles and fragments of organic remains, the color of which varies from transparent white, and passes through yellow, to the deepest and most opaque brown. M. Turpin recognized four different bodies; the first of which he referred to the genus *Gaillonella* of M. Bory St. Vincent, or *Conferva moniliformis;* the second he considered as a different species of the same genus; the third was a mixture of tubular filaments, divided into cells at rare intervals, and remains of infusoria; the fourth was not organic, but served as a basis for rendering the whole solid. The *Silex pyromaque* of Delitzsch, is much richer in organic productions, offering some very remarkable forms, probably belonging to the eggs of Polypi.—*Ib.*

26. *White Race of Atlas.*—M. Guyon, chief surgeon to the African army, writes to M. Dureau de la Malle, that at Bougia there is now living, a woman originally from the interior, supposed to be descended from the white tribe of Mount Aureps. She is at most twenty six or twenty-eight years of age, of very agreeable physiognomy, blue eyes, fair hair, beautiful teeth, and has a very delicate white skin. She is married to the Imaun of the mosques, Sidi Hamed, by whom she has three children, bearing a strong resemblance to herself. M. Arago observes, that these white people are not so rare in that part of the world as might be supposed, for when he was going from Bougia to Algiers, in 1808, by land, he saw women of all ages in the different villages, who were quite white, had blue eyes and fair hair, but that the nature of his journey did not permit him to stop and ask if they came from any peculiar tribe.—*Ib.*

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APPENDIX.

Notice of the Electro-Magnetic Machine of Mr. Thomas Davenport, of Brandon, near Rutland, Vermont.

MANY years have passed since motion was first produced by galvanic power. The dry columns of De Luc and Zamboni caused the vibration of delicate pendulums and the ringing of small bells, for long periods of time, even several years, without intermission.

In 1819–20, Prof. Oersted, of Copenhagen, discovered, that magnetism was evolved between the poles of a galvanic battery. Prof. Sweigger, of Halle, Germany, by his galvanic multiplier, succeeded in rendering the power manifest, when the galvanic battery was nothing more than two small wires, one of copper and the other of zinc, immersed in as much acidulated water as was contained in a wine glass.' The power thus evolved was made to pass through many convolutions of insulated wire, and was thus augmented so as to deflect the magnetic needle sometimes even 90°. Prof. Moll, of Utretcht, by winding insulated wire around soft iron, imparted to it prodigious magnetic power, so that a horse shoe bar, thus provided, and connected with a galvanic battery, would lift over one hundred pounds. About the same time, Mr. Joseph Henry, of Albany, now Prof. Henry, of Princeton College, by a new method of winding the wire, obtained an almost incredible magnetic force, lifting six or seven hundred pounds, with a pint or two of liquid and a battery of corresponding size; nor did he desist, until, a short time after, he lifted thousands of pounds, by a battery of larger size, but still very small, (1830.)

This gentleman was not slow to apply his skill to the generation of motion, and a successful attempt of his is recorded in this Journal, Vol. xx. p. 340. A power was thus applied to the movement of a machine, by a beam suspended in the center, which performed regular vibrations in the manner of a beam of a steam engine. This is the original application from which have sprung, or at least to which have succeeded, several similar attempts, both in this country and in Europe. A galvanic machine was reported to the British Association in 1835, by Mr. McGauly, of Ireland, and he has renewed his statements of successful experiments at the late meeting at Bristol. Mr. Sturgeon, of Woolwich, England, also reports a galvanic machine as being in use on his premises for pumping water, and for other mechanical purposes.*

But, I believe that Mr. Davenport, named at the head of this notice, has been more successful than any other person in the discovery† of a galvanic machine of great simplicity and efficiency. During the last two or three years, much has been said of this discovery in the newspapers, and it is probable, that in a future number of this Journal, drawings and an accurate description of the machine may be given. Having been recently invited to examine a working model, in two varieties of form, and to report the result, I shall now attempt nothing more than a general description, such as may render intelligible the account I am to give.

1. *The Rotary Machine, composed of revolving electro-magnets, with fixed permanent magnets.*

This machine was brought to New Haven March 16, 1837, by Mr. Israel Slade, of Troy, N. Y., and by him set in motion for my examination. The moving part is composed of two iron bars placed horizontally, and crossing each other at right angles. They are both five and a half inches long, and they are terminated at each end by a segment of a circle made of soft iron; these segments are each three inches long in the chord line, and their position, as they are suspended upon the ends of the iron bars, is horizontal.

This iron cross is sustained by a vertical axis, standing with its pivot in a socket, and admitting of easy rotation. The iron cross bars are wound with copper wire, covered by cotton, and they are made to form, at pleasure, a proper connexion with a small circular battery, made of concentric cylinders of copper and zinc, which can be immersed in a quart of acidulated water. Two semicircles of strongly magnetized steel form an entire circle, interrupted only at the two opposite poles, and within this circle, which lies horizontally, the galvanized iron cross moves in such a manner that its iron segments revolve parallel and very near to the magnetic circle, and in the same plane. Its axis at its upper end, is fitted by a horizontal cogwheel to another and larger vertical wheel, to whose horizontal axis,

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* Sturgeon's Annals of Electricity, Magnetism, &c. No. 1, Vol. 1. October, 1836.

† Mr. Davenport appears to have been strictly the inventor of a method of applying galvanism to produce rotary motion.

weight is attached and raised by the winding of a rope. As soon as the small battery, destined to generate the power, is properly connected with the machine, and duly excited by diluted acid, the motion begins, by the horizontal movement of the iron cross, with its circular segments or flanges. By the galvanic connection, these crosses and their connected segments are magnetized, acquiring north and south polarity at their opposite ends, and being thus subjected to the attracting and repelling force of the circular fixed magnets, a rapid horizontal movement is produced, at the rate of two hundred to three hundred revolutions in a minute, when the small battery was used, and over six hundred with a calorimotor of large size. The rope was wound up with a weight of fourteen pounds attached, and twenty eight pounds were lifted from the floor. The movement is instantly stopped by breaking the connexion with the battery, and then reversed by simply interchanging the connexion of the wires of the battery with those of the machine, when it becomes equally rapid in the opposite direction.

The machine, as a philosophical instrument, operates with beautiful and surprising effect, and no reason can be discovered why the motion may not be indefinitely continued. It is easy to cause a very gradual flow of the impaired or exhausted acid liquor from, and of fresh acidulated water into, the receptacle of the battery, and whenever the metal of the latter is too much corroded to be any longer efficient, another battery may be instantly substituted, and that even before the connexion of the old battery is broken. As to the energy of the power, it becomes at once a most interesting inquiry, whether it admits of indefinite increase? To this inquiry it may be replied, that provided the magnetism of both the revolving cross and of the fixed circle can be indefinitely increased, then no reason appears why the energy of the power cannot also be indefinitely increased. Now, as magnets of the common kind, usually called permanent magnets, find their limits within, at most, the power of lifting a few hundred pounds, it is obvious that the revolving galvanic magnet must, in its efficiency, be limited, by its relation to the fixed magnet. But it is an important fact, discovered by experience, that the latter is soon impaired in its power by the influence of the revolving galvanic magnet, which is easily made to surpass it in energy, and thus, as it were, to overpower it. It is obvious, therefore, that the fixed magnet, as well as the revolving, ought to be magnetized by galvanism, and then there is every reason to believe that the relative equality of the two, and of course their relative energy, may be permanently supported, and even carried to an extent much greater than has been hitherto attained.

2. *Rotating Machine, composed entirely of electro-magnets, both in its fixed and revolving members.*

A machine of this construction has been, this day, March 29, 1837, exhibited to me by Mr. Thomas Davenport himself, who came from New York to New Haven for that purpose.

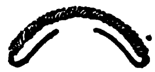
It is the same machine that has been already described, except that the exterior fixed circle is now composed entirely of electro-magnets.

The entire apparatus is therefore constructed of soft unmagnetic iron, which being properly wound with insulated copper wire, is magnetized in an instant, by the power of a very small battery.

The machine is indeed the identical one used before, except that the exterior circle of permanent magnets is removed and in its place is arranged a circle of soft iron, divided into two portions to form the poles.

These semicircles are made of hoop iron, one inch in width, and one eighth of an inch in thickness. They are wound with copper wire insulated by cotton—covering about ten inches in length on each semicircle and returning upon itself, by a double winding, so as to form two layers of wire, making on both semicircles about one thousand and five hundred inches.

The iron was not wound over the entire length, of one of the steel semicircles; but both ends were left projecting, and being turned inward, were made to conform to the bend of the other part, as in the annexed figure, which is intended to represent one of them; each end that is turned inward and not wound is about one third of the length of the semicircle. These semicircles being thus fitted up, so as to become, at pleasure, galvanic magnets, were placed in the same machine that has been already described, and occupied the same place that the permanent steel magnets did before. The conducting wires were so arranged, that the same current that charged the magnets of the motive wheel, charged the stationary ones, placed around it, only one battery being used. It should be observed, that the stationary galvanic magnets thus substituted for the permanent steel ones, were only about half the weight of the steel magnets. This modification of the galvanic magnet, is not of course the best form for efficiency; this was used



merely to try the principle, and this construction may be superseded by a different and more efficient one. But with this arrangement, and notwithstanding the imperfection of the mechanism of the machine—when the battery, requiring about one quart of diluted acid to immerse it, was attached, it lifted 16 lbs. very rapidly, and when the weight was removed, it performed more than 600 revolutions per minute.

So sensible was the machine to the magnetic power, that the immersion of the battery one inch into the acidulated water, was sufficient to give it rapid motion, which attained its maximum, when the battery was entirely immersed. It appeared to me that the machine had more energy with the electro-magnets, than with those that were permanent, for with the smallest battery, whose diameter was three inches and a half—its height five inches and a half, and the number of concentric cylinders three of copper and three of zinc, the instrument manifested as great power as it had done with the largest batteries, and even with a large calorimotor, when it was used with a permanent instead of a galvanic magnet. With the small battery and with none but electro or galvanic magnets, it revolved with so much energy as to produce a brisk breeze, and powerfully to shake a large table on which the apparatus stood.

Although the magnetization of both the stationary and revolving magnets was imparted by one and the same battery, the magnetic power was not immediately destroyed by breaking the connexion between the battery and the stationary magnet; for, when this was done, the machine still performed its revolutions with great, although diminished energy; in practice this might be important, as it would give time to make changes in the apparatus, without stopping the movement of the machine.

It has been stated by Dr. Ritchie, in a late number* of the London and Edinb. Phil. Magazine, that electro-magnets do not attract at so great a distance as permanent ones, and therefore are not well adapted for producing motion. On this point Mr. Davenport made the following experiment, of which I was not a witness, but to which I give full credit, as it was reported to me by Mr. Slade, in a letter dated New York, March 24, 1837.

Mr. Davenport suspended a piece of soft iron with a long piece of twine, and brought one pole of a highly charged steel magnet within the attracting distance, that is, the distance at which the iron was attracted to the magnet; by measurement, it was found that the steel magnet attracted the iron one inch and one fourth. A galvanic magnet was next used of the same lifting power, and consequently of much less weight; the attracting distance of this magnet was found to be one inch and three fourths, shewing a material gain in favor of the galvanic magnet. Mr. Slade inquires, "has Mr. Ritchie's magnet been so constructed as to give a favorable trial to this principle?"* Mr. Davenport informs me that each increase in the number of wires has been attended with an increase of power.

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* January, 1837.

Conclusions.

1. It appears then, from the facts stated above, that electro-magnetism is quite adequate to the generation of rotary motion.

2. That it is not necessary to employ permanent magnets in any part of the construction, and that electro-magnets are far preferable, not only for the moving but for the stationary parts of the machine.

3. That the power generated by electro-magnetism may be indefinitely prolonged, since, for exhausted acids, and corroded metals, fresh acids and batteries, kept always in readiness, may be substituted, even without stopping the movement.

4. That the power may be increased beyond any limit hitherto attained, and probably beyond any which can be *with certainty* assigned,—since, by increasing all the members of the apparatus, due reference being had to the relative proportionate weight, size, and form of the fixed and movable parts—to the length of the insulated wires and the manner of winding them—and to the proper size and construction of the battery, as well as to the nature and strength of the acid or other exciting agent, and the manner of connecting the battery with the machine, it would appear certain, that the power must be increased in some ratio which experience must ascertain.

5. As electro-magnetism has been experimentally proved to be sufficient to raise and sustain several thousands of pounds, no reason can be discovered why, when the acting surfaces are, by skillful mechanism, brought as near as possible, without contact, the continued exertion of the power should not generate a continued rotary move-

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* This question I am not able to answer, as I have not seen any account of the apparatus or of the experiment, but only of the result.

ment, of a degree of energy inferior indeed to that exerted in actual contact, but still nearly approximating to it.

6. As the power can be generated cheaply and certainly—as it can be continued indefinitely—as it has been very greatly increased by very simple means—as we have no knowledge of its limit, and may therefore presume on an indefinite augmentation of its energy, it is much to be desired, that the investigation should be prosecuted with zeal, *aided by correct scientific knowledge*, by *mechanical skill*, and by *ample funds*. It may therefore be reasonably hoped, that science and art, the handmaids of discovery, will both receive from this interesting research, a liberal reward.

Science has thus, most unexpectedly, placed in our hands a new power of great but unknown energy.

It does not evoke the winds from their caverns; nor give wings to water by the urgency of heat; nor drive to exhaustion the muscular power of animals; nor operate by complicated mechanism; nor accumulate hydraulic force by damming the vexed torrents; nor summon any other form of gravitating force; but, by the simplest means—the mere contact of metallic surfaces of small extent, with feeble chemical agents, a power every where diffused through nature, but generally concealed from our senses, is mysteriously evolved, and by circulation in insulated wires, it is still more mysteriously augmented, a thousand and a thousand fold, until it breaks forth with incredible energy; there is no appreciable interval between its first evolution and its full maturity, and the infant starts up a giant.

Nothing since the discovery of gravitation and of the structure of the celestial systems, is so wonderful as the power evolved by galvanism; whether we contemplate it in the muscular convulsions of animals, the chemical decompositions, the solar brightness of the galvanic light, the dissipating consuming heat, and, more than all, in the magnetic energy, which leaves far behind all previous artificial accumulations of this power, and reveals, as there is full reason to believe, the grand secret of terrestrial magnetism itself.

B. S.

New Haven, March 31, 1837.

Claim of Thomas Davenport.

In the words of the patent, taken out, this invention "consists in applying magnetic and electro-magnetic power as a moving principle for machinery, in the manner described, or in any other substantially the same in principle."

"Mr. Davenport first saw a galvanic magnet in December, 1833, and from the wonderful effects produced by suspending a magnet of 150 lbs. from a small galvanic battery, he immediately inferred, without any knowledge of the theory or the experiments of others, that he could propel machinery by galvanic magnetism. He purchased the magnet and produced his first rotary motion in July, 1834. In July, 1835, he submitted his machine to Prof. Henry, of Princeton, New Jersey, also without any knowledge of Prof. Henry's experiments in producing a vibratory motion. From this gentleman he received a certificate, testifying to the originality and importance of the invention."

Mr. Davenport is, by occupation, a blacksmith, with only a common education, but with uncommon intelligence; his age about thirty five. Mr. Ransom Cook, of Saratoga Springs, is associated with Mr. Davenport, and has rendered essential service by the improvements he has made in the machine, and by his assistance in bringing the subject before the public in the most effectual way. Arrangements have been made to take out the patent in Europe.

P. S. The proprietors are constructing a machine of seven inches in diameter, and also one of two feet in diameter. Galvanic magnets will be used as the moving and stationary magnets of each.

THE

AMERICAN JOURNAL

OF

SCIENCE AND ARTS.

CONDUCTED BY

BENJAMIN SILLIMAN, M. D. LL. D.

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ERRATA.

P. 21, l. 3 fr. bot. for *June* 11, 1811, read *June* 18, 1811.—P. 23, l. 2 fr. top, for *those* read *these*.—P. 27, l. 4 fr. top, for *successively*, read *successfully*.—P. 29, l. 18 fr. bot. for *Humphrey*, read *Humphry*.—P. 305, l. 2 fr. top, for *the American elk*, read *Cervus Alces*, L.

VOL. XXXII.

P. 305, l. 4 fr. top, for *bevel* read *level*; l. 3 fr. bot. after *wire*, add—"The number of divisions was then taken where the arms met."—P. 346, l. 21 fr. top, for *Collitelus*, read *Callitelus*.

ACKNOWLEDGMENTS TO CORRESPONDENTS, FRIENDS AND STRANGERS.

Remarks.—This method of acknowledgment has been adopted, because it is not always practicable to write letters, where they might be reasonably expected; and still more difficult is it to prepare and insert in this Journal, notices of all the books and pamphlets which are kindly presented, even in cases, where such notices, critical or commendatory, would be appropriate; for it is often equally impossible to command the time requisite to frame them, or even to read the works; still, judicious remarks, from other hands, would usually find both acceptance and insertion.

In public, it is rarely proper to advert to personal concerns; to excuse, for instance, any apparent neglect of courtesy, by pleading the unintermitting pressure of labor, and the numerous calls of our fellow-men for information, advice, or assistance, in lines of duty, with which they presume us to be acquainted.

The apology, implied in this remark, is drawn from me, that I may not seem inattentive to the civilities of many respectable persons, authors, editors, publishers, and others, both at home and abroad. It is still my endeavor to reply to all letters which appear to require an answer; although, as a substitute, many acknowledgments are made in these pages, which may sometimes be, as now, in part, retrospective.—*Ed.*

Books, Pamphlets, &c.

DOMESTIC.

A Discourse on Temperance and Stimulants in a warm climate, by E. H. Barton, M. D. New Orleans, 1837. From the author.

Familiar View of the Operation and Tendency of Usury Laws. New York, 1837. J. R. Hurd.

Catalogue of Chatham Academy—October, 1837, to January, 1837. Wm. H. Williams, the Principal.

Annual Report of the Common Schools, Academies and Colleges of Pennsylvania, by Th. H. Burrowes, Superintendent. From the Author.

An Act on Common Schools, with explanatory instructions, &c. by Thos. G. Burrowes. Harrisburg, Penn. 1837. The author.

Vindication of General Washington from the stigma of adherence to secret societies, by Joseph Ritner, Gov. of Pennsylvania. From Mr. Burrowes.

Geological Questions relating to the Survey of the state of New York. From W. W. Mather.

Charter of the Portage Canal and Manufacturing Company. Two copies.

Proceedings of the President and Fellows of the Connecticut Medical Society, in convention, May, 1837. From the Convention.

A System of Mineralogy, including a Treatise on Crystallography, &c. &c, by James D. Dana, A. M., Assistant in the department of Chemistry, Mineralogy and Geology in Yale College. The author.

An Essay on Indian Corn. 1837. From the author, Peter A. Browne, Esq.

Discourse before the Alumni of the University of Pennsylvania, July, 1836, by Th. J. Wharton. From the author.

Transactions of the Natural History Society of Hartford, No. 1. 1836.

Catalogue of Phenogamous Plants and Ferns, native or naturalised, near Baltimore. From the author, Wm. E. A. Aikin, M. D.

First Annual Report of the Executive Committee of the Young Men's Association, Buffalo, Feb. 8, 1837. From H. R. Wing.

Twenty First Annual Report of the Directors of the American Asylum at Hartford, 1837.

Extracts from the correspondence of the American Bible Society, April, 1837.

Vermont Courier, July 6, 1837, containing a notice of a meteor. The editor.

Kittaning Gazette, June 29, 1837, with a notice of electro-magnetism, by David Alter. The editor.

Address at the Sixth Annual Session of the Western Literary Institute, Cincinnati, 1837, by Albert Picket, Sen. The author.

A Narrative of the Dissolution of the Medical Faculty of Transylvania University. From the author, Prof. L. P. Yandell.

Cleveland Gazette, July 7, 1837, with a notice of an Aurora Borealis.

The Georgian, June 20, 1837—Notice of a Fountain under the Sea off St. Augustine.

New England Farmer, June 16, 1837.

The New Aurora, Vol. I. No. 1, June 17, 1837. Philadelphia.

An Examination of Phrenology, in two lectures, given in the Columbian College; two copies; by Thomas Sewall, M. D. Prof. of Anatomy, &c. From the author.

Introductory Lecture on Acclimation, by E. H. Barton, M. D. New Orleans, 1837. The author.

A Report of the Geological Survey of Connecticut, by C. U. Shepard, M. D. From the author.

Dr. S. H. Tyng's Sermon, Eighth Sunday School Anniversary, May 22, 1837. The author.

Thirteenth Annual Report of American Sunday School Union, May 23, 1837.

Twenty First Annual Report American Bible Society, 1837.

Richmond County Mirror of Science, Literature and News, Vol. I. No. 1. July, 1837.

Address delivered in the Chapel of the University of New York, on the occasion of its dedication, May 28, 1837.

Newark Daily Advertiser, July 28, 1837.

Suggestions on the reformation of the Banking System, by R. Hare, M. D. From the author. 2 copies.

Western Presbyterian Herald, Louisville, Ky. July 27, 1837. Tornadoes.

An Elementary Treatise on Sound, being the second volume of a course of Natural Philosophy, by Benj. Pierce, A. M., University Prof. of Math. and Nat. Philos. Harvard, Cambridge, 1836. From the author.

Catalogue of Officers and Students in Wabash College, 1837.

Report of a Geological Reconnaissance made in 1835, from Washington by Green Bay and the Wisconsin Territory, to the Coteau de Prairie, by G. W. Featherstonhaugh, Esq. From Hon. Gideon Tomlinson.

Mr. Farnham's Letter to the City Council of New Haven in relation to supplying the city with water from the Farmington Canal.

Vermont Chronicle, June 8, 1837, with Meteorological Register for May, 1837. Do. Aug. 16, with Meteor. Register for June, 1837.

New Era, N. York, June 9, 10 and 20, 1837. Sherwood's Discoveries.

Catalogue of Ellington School, 1837.

Monroe Democrat, Aug. 18, 1837. Polished Rocks. C. Dewey.

The People's Friend and Little Falls Gazette, May 27, 1830. From the editor.

Western Presbyterian Herald, Louisville, Ky. July 27, 1827; with account of a terrible Tornado at South Hanover. From Rev. J. Blythe.

The Genesee Farmer, Rochester, Vol. VII. Nos. 20, 21, 25, 26, 27, 29, May 20 to July 22, 1837. Willis Gaylord.

Flora Cestrica—the flowering and filicoid plants of Chester Co. Pa.; pp. 640, with a colored map. From the author, Dr. William Darlington.

Lyell's Geology, 2 vols. 8vo., first American, from fifth London edition. Kay & Brother, Phila. 1837. From the publishers.

D. Appleton & Co.'s Catalogue of English Publications. From the publishers.

Experimental Observations and Improvements in Apparatus, Manipulation, &c., by R. Hare, M. D. Phil. 1836. The author.

Catalogus Collegii Dartmuthensis, 1837. Prof. Hubbard.

Mr. Beach's Answer to Mr. Sigourney. From the author.

Annual Announcement of Lectures, &c. in Jefferson Med. Coll. 1837–8. 2 copies.

The Richmond County Mirror, several Nos. The editor.

Mr. Cozzens' Sermon on the death of the Hon. Wm. Reed.

The North American Spelling Book, by L. W. Leonard. 1836. Keene, N. Hampshire. From the publishers.

A New Grammar of the English Language. Boston, 1834. From the author.

Practical Instruction on Animal Magnetism, by J. P. F. Deleuze. From the translator, Mr. Thos. C. Hartshorn. 1837. Providence.

Catalogue of the Library of the Academy of Natural Sciences of Philadelphia, 1837. The Society.

History of Davenport's Invention of the Application of Electro-Magnetism to Machinery, &c. From Ed. Williams.

Circular Address of the President and Faculty of Louisville Medical College.

General Species and Iconography of Recent Shells, by L. C. Keiner; translated from the French by D. Humphreys Storer, M.D. No. I. From the publisher, Wm. D. Ticknor. Boston, 1837.

Boston Journal of Natural History, containing Papers and Communications read to the Boston Society of Natural History. Part 1. No. 4. The Society.

Rev. H. Winslow's Address before the Boston Nat. Hist. Soc. June 7, 1837. The author.

Rev. H. Winslow's Discourse on the Appropriate Sphere of Woman. Boston, July 9, 1837. The author.

Melanthacearum Americæ Septentrionalis revisio—auctore A. Gray. New York, 1337. The author.

Prospectus of the American Society for the Diffusion of Useful Knowledge—established October 17, 1836. From Gorham D. Abbott.

Circular of the University of the State of New York, Sept. 1837.

First Report of the Universal Lyceum, 1837.

Circular Address of the President and Faculty of the Louisville Medical Institute, 1837.

FOREIGN.

British Annual and Epitome of the Progress of Science, edited by Robert D. Thomson, M.D. London, 1837. The editor.

Select Catalogue of Books by James Kennett, 14 York Street, Covent Garden, London.

New Edinburgh Philosophical Journal, April to July, 1837.

British Annals of Medicine, Nos. 1 to 9, inclusive. In exchange.

London and Edinb. Phil. Mag. &c. Nos. 58, 59, 60. Do.

Loudon's Magazine, Dec. and Jan. 1836–7. Exchange.

London Journal, January and February, 1837. Do.

Mag. of Zoology and Botany, Nos. 1 to 6, inclusive. Exchange.

An Inaugural Lecture on the Study of Botany, by Prof. Daubeny, Univ. Oxford, Eng. 1834. The author.

Narrative of an Excursion to Lake Amsanctus and to Mount Vultur in Apulia, in 1834, by Prof. Daubeny. The author.

Transactions of the Society of Arts, &c. London, Vol. 51, Part 1. From the Society.

Address of the Pres. of the Geological Society, (Charles Lyell,) at the anniversary meeting of 1837. Author.

Lyell's Geology, fifth edition, 4 vols. 1837. From the author.

Proceedings of the Royal Society of Edinburgh, 1834, 5, 6. Nos. 4, 5, 7, 8, 9. From the Society.

The Durham Advertiser, England, for April 7th, 1837.

The Leeds Mercury, England, April 22, 1837.

Fourth Quarterly Report of the Ophthalmic Hospital, Canton, China, 1836. From Rev. P. Parker.

Brief Outlines, illustrative of the Alterations in the House of Commons in reference to the acoustic and ventilating arrangements. From the author, D. B. Reid, M. D. F. R. S. E. &c. &c.

Account of Experiments made in different parts of Europe on Terrestrial Magnetic Intensity. From the author, Prof. James D. Forbes.

Considerations on Modern Theories of Geology, by Rev. Thomas Gisborne, Durham, England. From Mr. Charles Fox, N.York.

Elemente der technischen Chemie, von Ernst Ludwig Schubarth, 3 vols. 8vo. with a folio atlas of plates. Berlin, (Prussia,) 1835. From the author.

Fourth Annual Report of the Royal Cornwall Polytechnic Society, 1836. From the Society.

Observations on Mineral Veins, by Robert Were Fox. From the author.

London Athenæum of June 24 and July 1, 1837, Nos. 504 and 505. From Wm. Vaughan, Esq. of London.

Discussion of the Magnetical Observations made by Capt. Back, R. N., during his late Arctic expedition, by S. H. Christie, Esq., M. D. F. R. S. &c. &c. From the author.

Observations on some of the strata between the Chalk and Oxford Oolite, in the S. E. of England, by Wm. Henry Filton; quarto, 300 pages, with numerous colored plates and charts. From the author.

Geological Notice of the New Country passed over by Captain Back during his late expedition; by William Henry Filton, M. D. F. R. S. G. S. &c.

London Mechanics' Magazine, &c. No. 701. From Mr. Curtis, London.

Catalogue d'Instrumens de Physique, Chimie, Optique, Mathematiques et autres a l'usage des Sciences. Pixii, Père et Fils; a Paris. 1835. Rue de Grenelle, St. Germain, No. 18.

Testimonials in Favor of Robt. Cunningham. A. M. Edinb.

Observations on Rail Ways or Turnpike Roads, by Alex. Gordon, Civil Engineer. From R. Cunningham.

History of the Inductive Sciences in all ages, by Rev. William Whewell, of Cambridge University, England, 3 vols. 8vo. London, 1837. From J. D. Dana.

Nouveaux Appareils, Electro-magnetiques—prix, A. M. Pixii, (Hippolite,) 1832.

Catalogue des principaux instrumens de physique, chimie, &c. &c. Pixii père et fils. Paris, Rue de Grenelle, St. Germain, No. 18. 1835.

Pictures, Minerals, &c.

Portrait of Rev. Peter Parker, Canton, China, by a native artist. From Mr. Parker, for the Picture Gallery of Yale College.

Portrait of the present Emperor of China. From the same.

Portrait of a Hong Merchant. From the same.

Specimens of native sulphur, of lava, of volcanic spun glass, (hair of the Goddess Pelé,) &c., from Hawaii. Mr. Goodrich, late Missionary.

Do. Do. From J. Diell, Seaman's Chaplain, Honolulu.

A small collection of Shells. From the same.

Oil of the Tutui, or candle nut tree. From the same—a painting, oil.

Specimens of rocks and minerals, from Greece and Asia Minor, Mt. Cynthus, Delos, Syra, Smyrna, Tenos, Athens, Malta, Cape Sunium, Milo, Paros, Santorin. From Rev. J. Robertson, Episcopal Missionary.

Many splendid specimens of crystallized mica in perfect and large crystals; of black tourmaline; primitive rhomboidal calc spar (Iceland crystal); chatoyant or Labrador feldspar; magnificent masses of galena, (Rome lead mine,) some of them in perfect crystals; specular iron; beautiful fluor spar; carbonate of lead; plumbago; perfect and large crystals of phosphate of lime, (apatite,) color deep green, elegantly implanted in yellow calc spar, &c. &c. From Dr. C. Crawe.

Specimens of the Marls of New Jersey. From J. M. Ely, Esq. New York, 1836.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Examination of the Theory of a Resisting Medium, in which it is assumed that the Planets and Comets of our System are moved*; by R. W. Haskins, of Buffalo, N. Y.

In all ages, when astronomy has been cultivated, the opinion seems to have been entertained, in some one or more of its numerous forms and modifications, that the regions around us, beyond our atmosphere, and to an indefinite extent, are supplied with a rare, invisible medium, of unknown composition and character, in which all the bodies of our solar system, and perhaps the bodies of all other systems also, in executing the several motions assigned them, are necessitated to move. To this substance the name of *ether* has usually been applied; and by this name we propose to designate it, while we examine into its history, the evidences of its existence, and its effects. The period at which this celestial ether was introduced into the science of astronomy, no less than the race of people by whom it was effected, is probably beyond the reach of inquiry: we know only that in the most remote periods of the history of that science, we find it constituting a prominent part of the celestial mechanism. The Bramins, of India, whose astronomical tables, constructed more than three thousand years before the Christian era, are still preserved to us,(1) assumed its existence, and figuratively supposed the stars to move themselves therein, in a manner similar to the movement of fish in water.(2) The name by which it was known to them is *akash;* and Mr. Dow, in his dissertation upon the religion of the Bramins, defines it to be "a celestial element, pure and impalpable, in which the planets move." "This element," he continues, "according to Bedang, offers no resistance; so that the planets have moved uninterruptedly therein, from their first impulsion which they received from the hand of Brama; and they will not be arrested until the moment when he shall seize them in the midst of their course."(3) The Chaldeans, also, held this opinion, and in the figurative language of the East were wont to represent the planets, including the sun, the earth and the moon, as vessels moving therein, and suited to such navigation.(4) Alhazen, an Arabian optician of the eleventh century, taught the existence of ether, which he designated "the substance of heaven," and he supposed it situated beyond, and differing in character from, our atmosphere.(5) Tycho Brahe reinstated the ether of the ancients in all its rights. But though he regarded it as existent, he denied to it the power of causing refraction, which he attributed solely to the grosser vapours of our atmosphere. Whatever may be the difference in the natures of these two fluids, says he, the atmosphere so diminishes in density upward, that at the point where it touches the ether it differs little from it.(6) Kepler, in following the crowd who had gone before him, revived this theory, in his day, and turned the substance in question to good account in framing some of the absurd theories which he put forth, along with his immortal discoveries. In seeking the origin of comets, he supposed them native inhabitants of this ether, as fishes are of the waters of the earth; and that God created them to inhabit the immense spaces of the universe, as he did whales and other monsters to people the vast solitudes of the ocean. The sombre and bloody appearance which the sun sometimes exhibits he attributed to a coagulation of the ether; and when these appearances ceased, that result was produced by a collection of the grosser portions, which had disturbed its transparency, and their conversion into comets.(7)

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(1) Bailly, Traite de l'Astronomie Indienne et Orientale: Prof. Playfair's works, articles Astronomy of the Bramins, and Trigonometry of do.; Hutton's History of Algebra, and Rev. S. Vince's complete System of Astronomy, Vol. 2, p. 252.

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(2) Bailly, Histoire de l'Astronomie Ancienne, p. 115.

(3) Bailly, Traite de l'Astronomie Indienne et Orientale, p. 206. The work of Mr. Dow we have not seen.

(4) Bailly, Histoire de l'Astronomie Ancienne, p. 139.

(5) Bailly, Histoire de l'Astronomie Moderne, tome 1, p. 238.

(6) Ibid. tome 1, p. 404.

(7) Ibid. tome 2, p. 124.

Through the long period of time embraced by these references, we see the existence of this fluid matter every where accredited; yet so vague and indefinite do all ideas respecting it appear to have been, that rigid investigation of its character or necessity seems to have been quite neglected; and even its practical utility, so far as we know, was but very limitedly considered. But we are now to enter upon a new era, and that a very important one, in the history of this fluid; for we are to see it elevated from the subordinate station hitherto assigned it, to that of a primary agent in carrying out the great motions of the universe. This application was the offspring of the genius of DESCARTES. The conception was a sublime one which dared to identify the law of the general movement of the universe, with that of the movement of terrestrial bodies: and this is due to Descartes. His vortices are a bad explanation of gravity and of the system of the world, but they are mechanical. He discovered that the same mechanism moved bodies in the celestial spaces and at the surface of the earth; and if he was not able to seize this mechanism, we should not forget that this new and sublime thought was of his conception.(8) According to this philosopher "matter, possessed only of the properties of extension, impenetrability and inertia, was supposed to fill all space, and its parts, both great and small, to be endued with motion in an infinite variety of directions. From the combination of these, the rectilineal motion of the parts became impossible; the atoms or particles of matter were continually diverted from the lines in which they had begun to move; so that circular motion and centrifugal force originated from their action on one another. Thus matter came to be formed into a multitude of vortices, differing in extent, in velocity and density; the more subtile parts constituting the real vortex, in which the denser bodies float, and by which they are pressed, though not equally, on all sides. Thus the universe consists of a multitude of vortices, which limit and circumscribe one another. The earth and the planets are bodies carried round in the great vortex of the solar system; and by the pressure of the subtile matter, which circulates with great rapidity, and great centrifugal force, the denser bodies, which have less rapidity, and less centrifugal force, are forced down toward the sun, the centre of the vortex. In like manner, each planet is itself the centre of a smaller vortex, by the subtile matter of which the phenomena of gravity are produced, just as with us at the surface of the earth."(9) In this system of philosophy, if such it may be called, the agency of the ether, in causing and sustaining the planetary motions, is indispensable; and when we consider how universal was the belief, by all learned and scientifick men, in this doctrine, for more than half a century, we find a ready excuse for the opinion of the less informed upon the subject. For more than thirty years after the publication of Newton's discoveries, this absurd doctrine of vortices kept its ground in France, Germany, and in the universities of England and Scotland. It was finally driven out of the Cambridge University, in England, by a friend of Newton's publishing, in 1718, an edition of their Cartesian text book, *with notes*, embracing the truths which Newton had disclosed. These gradually undermined the doctrine of Descartes, and finally caused its expulsion.(10) This, however, was a work of time; and the absurdities in question were not generally, or even in any considerable degree, driven from the colleges and learned societies of Europe, before about the year 1720.(11)

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(8) Bailly, Histoire de l'Astronomie Ancienne, Discours Préliminaire; and Playfair on Mathematical and Physical Science.

When the errours of Descartes were finally removed from the schools, and from the minds of philosophers, they gave place to the Copernican system of the universe, as rigidly demonstrated by Newton, upon the basis of the laws of Kepler. By this system, and these demonstrations, the celestial revolutions are shown to be carried on independently of all assistance from the ether; and the agency of that fluid was consequently no longer demanded. But, though thus discarded from all participation in planetary motion, a belief in the existence of this fluid was still retained by Newton, who sought to employ it in a new capacity. "And now we might add something concerning a certain most subtile spirit, which pervades and lies hid in all gross bodies; by the force and action of which spirit, the particles of bodies mutually attract one another at near distances, and cohere if contiguous; and electrick bodies operate to greater distances, as well repelling as attracting the neighbouring corpuscles; and light is emitted, reflected, refracted, inflected, and heats bodies."(12) He furthermore supposed that this substance is spread through all the heavens; and when for lack of demonstration, uncertainty arose in his mind, he thus queried: "Is not this medium much rarer within the dense bodies of the sun, stars, planets and comets, than in the empty celestial spaces between them? And in passing from them to great distances, doth it not grow denser and denser perpetually, and thereby cause the gravity of those great bodies towards one another, and of their parts towards the bodies; every body endeavouring to go from the denser parts of the medium towards the rarer?"(13)

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(9) Playfair on Mathematical and Physical Science, part 1, Sec. 4, Art. 4.

(10) Ibid. part 2, Sec. 4.

(11) It is, then, no more than about one hundred and seventeen years since even the learned world became sane upon the grand outline, alone, of the celestial mechanism. Three of the colleges of our own country were founded prior to that date, namely, Harvard, in 1638; William and Mary, in 1693; and Yale, in 1700. At that early period of our history, and with the professors' chairs, in these institutions, generally occupied by European scholars, we can hardly suppose wide deviations, in the doctrines taught, from the received opinions in Europe; and consequently, without any direct proof at hand, upon this point, we from necessity infer that the New World has just claims to a portion of whatever of renown or reproach may rightfully attach to the inculcation of the Cartesian doctrine of the universe, at so late a day; and that, for a period of eighty years, this was gravely taught and believed at one, and for shorter periods at two other of the colleges of our infant country.

In 1762 the Academy of Sciences, of Paris, proposed, for a prize, the question, "*Do the planets revolve in a medium of which the resistance produces a sensible effect upon their movements?*" For this prize *M. l'abbé Bossut* was the successful competitor. His calculations showed him that the effect of resistance, offered to the planets, would be to diminish the axis of their orbits, and consequently to shorten their periods of revolution. An acceleration in the movements of the moon had been observed, which was without explanation, and on applying his reasonings to the motions of this planet he satisfied himself that the observed acceleration was due to the resistance of ether, encountered by the moon, in traversing her orbit. The sum of that resistance he measured; and this theory being equally applicable to all the planets, he extended it to them all, and subjected each to the resisting influence of the ether.(14)

The tails of comets were objects of early attention; and it was remarked, both by *Fracastor* and *Apian*, that the tail of the comet of 1531, and those of two subsequent ones, *were all directed opposite to the sun.*(15) Pingré subsequently supposed that these tails are formed of the most subtile portions of the comet's atmosphere, greatly rarefied by the sun, and driven to the side *opposite the sun*, by the resistance of the ether; aided, perhaps, by the solar rays.(16) This direction of comets' tails, as laid down by Fracastor and Apian, seems to have been very universally adopted. *Newton* says the tails of cómets arise from their heads, and tend towards the parts opposite to the sun.(17) *Bailly* adopts the same opinion, in strong language, namely, that the tails are always opposite the sun.(18) *Delambre* is equally unreserved. He says the tail of a comet is always opposite the sun, or in prolongation of the radius vector of the sun and the comet.(19) *Laplace* calls them trains of vapour, always situated on the other side of the heads of comets, relatively to the sun.(20) *Vince* says comets are surrounded by a dense atmosphere, and from the side opposite the sun they send forth a tail.(21) *Bonnycastle* denominates them fiery tails, which continually issue from that side of the comets which is farthest from the sun.(22) *Brewster* states that when a comet is near its perihelion, it is accompanied with a tail or train of light, directly opposite the sun.(23) *Morse* avows that comets are usually attended with a long train of light, always opposite to the sun.(24) *Prof. Farrar*, of Harvard, describes the trains, and adds, their direction is always opposite to the sun.(25) The younger *Herschel* describes the nucleus, and adds that from the head, and in a direction *opposite to that in which the sun is situated* from the comet, appear to diverge two streams of light, constituting the tail.(26) Sustained by the high standing and great numerical force of these authorities, the position here assumed has quite regularly found credence and a place in the numerous works of subordinate authors; insomuch that we have pretty uniformly recognized it in the elementary works upon astronomy that we have examined in the English language.(27)

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(12) Newton's Mathematical Principles of Natural Philosophy, vol. 2, p. 393. The copy of Newton to which all references in this article are made is the English translation, by Andrew Motte, 12 mo. edition, in two vols. London, 1729.

(13) Newton's Opticks, third edition, London, 1721, p. 325.

(14) Bailly, Histoire de l'Astronomie Moderne, tome 3, p. 237; and Bossut, Histoire des Mathématiques, tome 2, p. 409.

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(15) Delambre, Histoire de l'Astronomie du Moyen Age, p. 390 et 393.

(16) Delambre, Histoire de l'Astronomie du Dix Huitième Siècle, p. 680. The work of Pingré, namely, *Cométographie*, we have not seen.

(17) Math. Prin. of Nat. Phil. (vide note 12,) vol. 2, p. 364.

(18) Histoire de l'Astronomie Moderne, tome 2, p. 549.

(19) Astronomie Theorique et Practique, tome 3, p. 401.

(20) Systéme du Monde, p. 128.

(21) Complete System of Astronomy, vol. 1, p. 444.

(22) An Introduction to Astronomy, p. 44.

(23) Edinburgh Encyclopedia.

(24) American Universal Geography, vol. 1, p. 32.

(25) Cambridge course of Natural Philosophy, fourth part, p. 306.

(26) A treatise on Astronomy, first published in 1833; American edition, p. 284.

The cause assigned for this direction of comets' trains, by Pingré, namely, the resistance of the ether, appears not to have found much favour in the minds of his successors; consequently we find, in general, the expression employed, namely, "*impulsion of the sun's rays,*" to denote both the agent and the manner of that agent's action, in producing this result.

Great additional impulse has, within a few years, been given to the theory of a resisting medium by the detailed and able paper of Prof. Encke, upon the observed decrease of the times of revolution of the comet which bears the name of that astronomer. This paper has been translated into English, and is more or less extensively quoted by almost every writer who has employed his pen upon celestial motions, since the date of its appearance. The author says: "If I may be permitted to express my opinion on a subject which, for twelve years, has incessantly occupied me, in treating which I have avoided no method, however circuitous, no kind of verification, in order to reach the truth, as far as it lay in my power; I cannot consider it otherwise than completely established, that an extraordinary correction is necessary for Pons' [Encke's] comet, and equally certain that the principal part of it consists in an increase of the mean motion proportionate to the time."(28) Dr. Bowditch, by reference to the memoir of Encke, supposes the existence of a resisting medium highly probable, as there disclosed, in the motions of Encke's comet, in its successive appearances between the years 1786, and 1829.(29) Arago, of the Royal Observatory, at Paris, in an essay, in 1832, fully recognizes this resisting medium, on the authority of Encke, and dwells at considerable length upon its effects.(30) M. Gautier assumes that, results obtained in 1828, from the movement of Encke's comet, accord with those which Encke had previously procured, and which induced him, (Encke,) in 1823 to suppose the existence of a medium or ethereal fluid, in space, of which the resistance, acting as a tangential force against the motion of the comet, would augment the power of the sun, and shorten the period of revolution.(31) The younger Herschel refers to Encke's memoir; admits its conclusions, if the premises shall be found valid, and adds: "accordingly, (no other mode of accounting for the phenomenon appearing,) this is the solution proposed by Encke, and generally received."(32) Mrs. Somerville, adverting, also, to Encke's memoir, deems the existence of resisting ether rendered "all but certain, within a few years, by the motion of comets;" and this insinuated negation she quite recalls some eight pages afterwards, by substituting the emphatick words, "which puts the existence of ether beyond a doubt." The same pen not only prophesies that by this resistance, comets will be finally precipitated upon the sun, but also that "the same cause may affect the motions of the planets, and be ultimately the means of destroying the solar system."(33) Upon this memoir of Encke, theological arguments have been founded, having for their object to prove the destruction of the solar system, through the agency of this ether; and so certain has that result been considered, upon this authority, that the most positive forms of expression have been employed in pointing to such a consummation.(34)

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(27) Some of the recent French works, of a similar character, constitute exceptions to this rule.

(28) Prof. Encke's Memoir, as quoted in the American Almanack, 1834.

(29) Mécanique Céleste, (Bowditch,) translator's note, vol. 3, p. 678.

(30) Tract on Comets, by Arago, translated into English, by Prof. Farrar, Boston, 1832.

It is believed that we have assembled, above, the leading facts and arguments upon the *affirmative* of the position of a resisting medium to the planets, so far as to embrace all that is requisite and necessary for a clear understanding and subsequent impartial investigation of the question. The method of division incident to this arrangement has been adopted in the belief that such arrangement would afford a view, more distinct than any other, of the entire question. We proceed, then, to subject the several positions and arguments to examination, in the order of their occurrence.

The evidences, if any, upon which the Bramins and the Chaldeans founded their belief in the existence of this ether, not having come down to us, the reasons for their faith are placed beyond investigation: nor are we better circumstanced in relation to the opinions of Alhazen, Tycho Brahe, and some others who, while they supposed such ether to occupy the celestial regions, gave no demonstration of the fact, nor made application of it to any of the known purposes of the universe. The opinions of Kepler, upon this subject, may not have received less credence, in the day they were uttered, than did his discovery of the fundamental laws of the celestial movements; but they were promptly consigned to oblivion by the subsequent revelation that comets, no less than planets, belong to our solar system, and move in ellipses more or less elongated, about the sun, obeying the same laws as the grosser planets. Of Descartes' system, and of its fate, we have spoken. That system was undermined by the discovery and application of the law of universal gravitation; and as this ether constituted all that was most essential to the Cartesian doctrine, the celestial motions were no sooner found to be carried on independently of its aid, than the whole theory was abandoned. Newton, himself, as we have seen, applied this substance, under the name of "a most subtile spirit," to the production of certain results, in his Principles of Natural Philosophy, and again in his Opticks. The passages we have quoted. These positions appear to have had their origin in a desire so to explain the doctrine of gravitation as to free it from the implied assertion that bodies act in places where they are not—a form of attack which the metaphysicians chose to employ against it. Yet this was but subjecting the question to new difficulties; as there is nothing like a satisfactory explanation of gravity in the existence of this elastick ether. True, a fluid disposed as Newton has assumed, would urge bodies in the direction he supposed; but what could maintain this fluid in the condition of its density varying according to the assumed law, is as inexplicable as the gravity it was meant to explain. The nature of such a fluid, if unrestrained, must be to equalize the density of all its parts, to the destruction of this hypothesis.(35) That Newton did not consider gravity inherent in matter is manifest from the passages under consideration; and he most fully states this, in words, in one of his letters to Dr. Bentley, as quoted by Prof. Playfair. Yet how he should have supposed he had escaped its necessity by his resort to the agency of this ether—since it is clearly for this purpose that he sought its aid—may well be deemed inexplicable. "If two particles of matter, at opposite extremities of the diameter of the earth, attract one another, this effect is just as little intelligible, and the *modus agendi* is just as mysterious, on the supposition that the whole globe of the earth is interposed, as on that of nothing, whatever, being interposed, or of a complete vacuum existing between them. It is not enough that each particle attracts that in contact with it; it must attract the particles that are distant, and the intervention of particles between them does not render this at all more intelligible."(36) We may close this point of investigation, by arraying Newton against himself. Notwithstanding the force with which Newton supposed bodies to be urged by the unequal density of the ether, in certain directions, yet, when treating of the tails of comets, his language is, "from whence, again, we have another argument proving the celestial spaces to be free and without resistance, since in them not only the solid bodies of the planets and comets, but also the extremely rare vapours of comets' tails maintain their rapid motions with great freedom, and for an exceeding long time,"(37) To such and kindred anomalies have the greatest minds been occasionally subject, in all ages.

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(31) Silliman's Journal of Science, vol. 17, p. 389.

(32) A Treatise on Astronomy, American ed. p. 291.

(33) Mrs. Somerville on the connection of the Physical Sciences.

(34) Astronomy and General Physicks, considered with reference to Natural Theology (one of the Bridgewater treatises) by the Rev. W. Whewell, of Trinity College, Cambridge.

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(35) Playfair on Math. and Phys. Science, pt. 2, sec. 4.

We have seen that, in 1762, this theory of resistance had so far commanded attention that the French Academy offered, in that year, a prize for the best examination of it; and we have also seen upon what evidences this prize was awarded. The results of the most careful modern observation, compared with those of a very ancient date, including some eclipses observed at Babylon, as early as 719, 720, and 721 years before the Christian era, show very clearly that the period of the moon's revolution is shorter in modern than in those remote ages.(38) This acceleration, Dr. Halley, the English astronomer, in 1695, believed to exist, and declared his conviction that he could demonstrate the fact.(39) A more detailed and extensive labour of comparison was subsequently performed by the *Rev. Richard Dunthorne,* who, in 1749, published its results, and verified the truth of the suspicions of his predecessor.(40) It was the cause of this acceleration which the French Academy demanded, in 1762. *M. l'abbé Bossut* sought that cause in the resistance of ether; and believing he had discovered it there, he made such returns of his labours to the Academy, that the proffered prize was awarded him: nor was the errour into which he had fallen, discovered for almost a quarter of a century afterwards. In 1786, however, the true cause was revealed. In that year *M. le Marquis de Laplace* discovered both the cause and the law of this acceleration. He demonstrated that it is produced by the action of the sun upon the moon; that it varies with the eccentricity of the terrestrial orbit, and consequently that such acceleration is a necessary result of the law of universal gravitation.(41) In a chapter founded upon the assumed possibility of a resisting ethereal fluid, Laplace says: "Hence it follows, that the resistance of the ether can become sensible, in the moon's mean motion only. Ancient and modern observations evidently prove that the mean motions of the moon's perigee and nodes are subject to very sensible secular inequalities. The secular motion of the perigee, deduced from the comparison of ancient and modern observations, is less by eight or nine sexagesimal minutes, than that which results from the comparison of the observations made in the last century. This phenomenon, of which no doubt can remain, must, therefore, depend upon some other cause than the resistance of ether. We have seen that it depends on the variation of the eccentricity of the earth's orbit; and, as the secular equations resulting from that variation satisfy, completely, all the ancient and modern observations, we may conclude that the acceleration, produced by the resistance of an ethereal fluid, on the moon's mean motion, is yet insensible."(42) Again: "the accordance of theory with observation proves to us that if the mean movements of the moon are varied by causes foreign to the law of universal gravity, their influence is so small as not yet to have become sensible."(43)

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(36) Playfair on Math. and Phys. Science, pt. 2, Sec. 4. See, also, preface to Newton, by Roger Cotes.

(37) Math. Prin. of Nat. Phil. (vide note 12,) vol. 2, p. 369.

(38) Delambre, l'Astronomie au Dix-Huitième Siècle, p. 597, *note de l'editeur.*

(39) Philosophical Transactions of the Royal Society of London, abridgment by Hutton, Shaw and Pearson, vol. 4, p. 65. All references to the transactions of this Society, made in the course of this article, will be to the same edition here designated.

(40) Ibid. vol. 9, p. 669, and onward.

The errour of *Fracastor* and *Apian*, in regard to the uniform direction of the tails of comets, has enjoyed an extent of credence not often secured to a false position. Although a direction nearly in prolongation of the radius vector of the sun and the comet is not unusual for these tails, yet observations very early furnished exceptions enough to destroy the rule which has been so long adhered to in this particular. If, as Pingré supposed, the resistance of ether has any agency in producing these tails, we should always expect them to be situated *behind* the nucleus, relatively to the comet's actual motion, without relation to the position of the sun: but this is not so. Indeed they form so many different angles, both in regard to the comet's line of motion, and to the relative position of the sun, that no settled fact seems deducible from the circumstance of their direction. Flamsted, in his account of a comet which he observed at Greenwich, in May, 1677, is at the pains to state that its tail was not directed in a line opposite the sun, but deviated therefrom at an angle of ten degrees.(44) Hevelius, of a comet he observed, in 1682, says, "sometimes its tail was directed pretty exactly in opposition to the sun, as August 30, in the morning; but often with a considerable deviation, as is usual in most comets."(45) The great comet of 1744 had, at one time, no less than *six* distinct tails, spread out like a fan. They were each about 4° broad; and the space between these several tails was as dark as the rest of the heavens. There exist other examples of the tails of comets which have separated into several branches.(46) Newton cites two comets, the tails of which deviated from a right line joining the sun and comet, one ten, and the other no less than twenty one degrees.(47) The comet which appeared in January, 1824, besides the usual tail, opposite the sun, had another directed from the nucleus of the comet *towards* the sun. "The singular form of this comet," says the narrator, "adds new difficulties to the problem by which it has been explained, in a manner quite satisfactory, that the impulsion of the sun's rays is the principal cause of comets' tails always taking a direction opposite to the sun."(48) Much that has been written upon the cause, nature and character of these peculiar appendages of comets, appears to have been based entirely upon assumed data. Such authority is alike unsafe and detrimental. The views of Arago are more sane, and therefore more valuable. "Kepler supposed the formation of the tails of comets was the result of the impulsion of the solar rays, which detached from the head of the comet the lighter portions of that body, and removed them to a distance beyond it. To render this explanation admissible it is necessary to prove that the solar rays are endowed with an impulsive force; for the most delicate experiments have hitherto failed to render such force perceptible. This force shown and admitted, it will still remain to be demonstrated why the tail is not always situated opposite to the sun; why there are sometimes several tails, making, one with another, so great angles; why they form and again vanish, in so short periods of time; why some of them have a rapid rotary motion; and finally, why some comets, of which the envelope seems very light and delicate, exhibit no trace of this appendage. A crowd of other theories, more or less ingenious, have been proposed; but they all equally fail to explain the phenomena."(49)

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(41) Delambre, l'Astronomie au Dix-Huitième Siècle, p. 598.

(42) Mécanique Céleste, (Bowditch,) vol. 3, p. 694.

(43) Système du Monde, p. 229.

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(44) Philos. Trans. of the Royal Society, (vide note 39,) vol. 2, p. 394.

(45) Ibid. p. 559.

(46) Delambre, l'Astronomie au dix-Huitième Siècle, p. 680; et Delambre, Astronomie Théorique et Practiqne, tome 3, planche. Also, Arago, tract on Comets, Farrar's translation.

(47) Math. Prin. (vide note 12,) vol. 2, pp. 360 and 364.

(48) Jambon, Nouveau cours démonstratif et élémentaire d'Astronomie, p. 330, et 331.

The enormous length to which these tails have sometimes attained, has given rise to theories no less fanciful, nor yet more philosophical, respecting the consequences of such elongation. Newton supposed that the extremely distant portions of these tails could never be recalled, by attraction, to the nucleus of the comet, but must be scattered through the heavens, to be subsequently gathered to the different planets by attraction, and mingled with their atmospheres, to be there appropriated to supply the waste of matter spent upon vegetation, &c.(50) Laplace, the younger Herschel, and some others among the moderns, have assumed that portions of comets' tails are, at each revolution, "*scattered in space*," and that, consequently, these bodies are continually wasting away. So indefinite a phrase seems not well calculated to convey any idea of facts; for we must suppose the matter of these tails, however elongated from the nucleus of the comets, will still obey the laws of gravitation to those bodies, unless brought within the *stronger* attraction of some other body: and in either case no dissemination of matter would take place. But the diminution of comets from loss of matter, by any cause, seems not well sustained. It is true that Arago, in 1832, fully concurred in this view; and hence advised us that in the then approaching return of Halley's comet we must not expect to behold so brilliant a body as the same had been at former periods of its return to the sun.(51) But this opinion of that astronomer he did not find supported by the actual appearance of Halley's comet, in 1835; and this fact he has promptly announced. He has, also, collectively presented what has come down to us of the apparent size, length of tail, &c. of Halley's comet at its various former apparitions; and contrasted this with the results of the careful and accurate observations upon the same body, made at various points, during its last appearance. At the close of these he adds: "If the reader will take the trouble to compare what I record of the comet of 1835 with the circumstances of its former apparitions, he certainly will not find in this collection of phenomena, *the proof* that Halley's comet is gradually diminishing. I will even say that if, in a matter so delicate, observations made at very different periods of the year, will authorize any positive deduction, that which would most distinctly result from the two passages of 1759 and 1835, would be that the comet had increased in size during that interval. I ought to seize, with the more eagerness, this occasion to combat an errour extensively accredited, (a belief in the constant wasting away of comets,) because I believe I have somewhat contributed to its dissemination."(52) This review of the theory of the diminution of comets, otherwise foreign to our subject, seemed demanded by the assumption of some that matter thus lost from these bodies will remain diffused through the celestial regions, of course offering constant obstruction to the progressive motion of the planets and comets. How such matter is to be maintained in this state of diffusion, has not, so far as we know, been explained; nor is it easy for us to conceive how the body resisted or encountered by it shall be prevented from appropriating it to itself, by adding it to its own mass.(53)

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(49) Arago, Leçons d'Astronomie Professées á l'Observatoire Royal, p. 207—8.
(50) Math. Prin: (vide note 12,) vol. 2, p. 371.
(51) Tract on Comets.

Comets, from their great volumes, as compared with their masses, have justly been considered, of all celestial bodies, the most necessarily subject to the action of any resisting medium there may be in the regions in which they are moved. They are known to be subject to great disturbances, in their orbits, by the attraction of the planets of the solar system; and revolving as they do in ellipses of great eccentricity, many of these bodies having their aphelions at such immense distances as are not readily appreciable, by any of our methods of computation, their motions are much less subject to rigorous demonstration than those of the planets.(54) Still so much confidence had Prof. Encke in the conclusions he had been able to draw, in the paper we have mentioned, that the movements of all these bodies which have been visible since its publication have been observed with increased care and assiduity; while the most rigid investigations of their former movements have not been overlooked.

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(52) Arago, Sur la dernière apparition de la comète de Halley; Annuaire, pour l'an 1836.

(53) The following "poetical license" occurs in the younger Herschel's Treatise on Astronomy, a late work, now used in some of the schools of this country. It contrasts very strangely with the really sane and valuable portions of that work, and it would hardly be supposed possible that it is from the same pen with these. The author is treating of Zodiacal light, upon which he thus fancifully expresses himself. "It is manifestly in the nature of a thin, lenticularly-formed atmosphere, surrounding the sun, and extending at least beyond the orbit of Mercury and even Venus, and may be conjectured to be no other than the denser parts of that medium, which, as we have reason to believe, resists the motion of comets; loaded, perhaps, with the actual materials of the tails of millions of those bodies, of which they have been stripped, in their successive perihelion passages, and which may be slowly subsiding into the sun"!

According to Prof. Encke, the comet which bears his name, in its several revolutions, between 1786 and 1819, exhibited a mean decrease in the times of those revolutions. Now, as resistance, from an ethereal medium, would have the effect, by diminishing the velocity of the comet, to lessen its centrifugal force, and thus force it down nearer the sun, it follows that precisely the result which Encke observed, would be the effect of such resistance. To the agency of ether, therefore, was this diminution ascribed, though not until after all other circumstances which were supposed to have had any agency in the result had been carefully considered. Biela's comet, or the comet of six years and three quarters, was also observed with reference to this action of resisting ether; as was, finally, the comet of Halley, whose last disappearance was in 1836. These three are the only ones, of all that have been seen, whose regular, periodical return is known, at the present day. The acceleration in the mean motion of Encke's comet if not due to the resistance of ether, is still unexplained. Biela's comet, in its return, in 1832, was also retarded, "but it throws new perplexity upon the question of a resisting medium. Encke and Gauss find a diminution of nine tenths of a day in the observed duration of its period, due to this resistance. Valz, from the computations of Damoiseau, finds this diminution to be eight tenths. Prof. Santini, from his own elements finds four tenths, while Encke's formula and constant, for computing this acceleration, only accounts for a diminution of three hundredths of a day. The mean of the three results would show that Biela's comet experiences the resistance of a medium twenty-five times as powerful as that which is encountered by Encke's comet."(55) Halley's comet remains to be noticed. We have seen that the two above were accelerated, though very unequally, the cause of which was supposed to be the resisting ether. But Halley's comet, in its return to its perihelion, in 1835, was, from some cause, detained beyond its time for arriving at that point—a result directly opposite to that in the case of the other two bodies. "In traversing a resisting ether the comet of Halley would have arrived at its perihelion, in 1835, sooner than if moving in a void; now on the contrary, according to the calculations of M. Rosenberg, that body, by observation, was *six days* behind its time, according to the results of calculations disconnected from any allowance for the action of resisting ether. The difference, though much less, found by M. Pontecoulant, is of the same kind! Hitherto, then, the last appearance of Halley's comet has added nothing to our knowlege of the phyical constitution of the celestial spaces."(56)

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(54) Too many authors of just renown, have overlooked perspicuity, and written vaguely, upon this point. Brewster, (Encyclopedia,) has not wholly escaped the charge of sacrificing philosophical accuracy to euphony, in the following: "Traversing unseen the remote portion of its orbit, the comet wheels its ethereal course far beyond the limits of our system. What regions it there visits, or upon what destination it is sent, the limited powers of man are unable to discover. After the lapse of years, we perceive it again returning to our system, and tracing a portion of the same orbit round the sun, which it had formerly described." If it leave the sphere of our sun's attraction must it not of necessity, gravitate to some other body, and be thus prevented from ever returning? Laplace, (Système du Monde,) has been more careful. "Innumerable comets, after having approached the sun, are elongated from it to such distances as to prove that its empire extends much beyond the known limits of our planetary system."

We have said the acceleration of these bodies is unaccounted for: so is the retardation; but we shall presently see whether other agents than ether may, within the bounds of probability, be supposed to give rise to these. Clairaut, in announcing to the French Academy, in 1758, that the then expected return of Halley's comet would be retarded six hundred and eighteen days beyond its previous period, by the combined action of Jupiter and Saturn, adds that, "a body which traverses regions so elongated from the sun, and which escapes, for so long periods, from our view, may be subject to forces totally unknown; such as the action of other comets, or even of planets, so distant from the sun as to have remained hitherto undiscovered."(57) Uranus was unknown until 1781, twenty three years after this announcement; and four other planets, belonging to our system, have been discovered within the present century—in all

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(55) S. C. Walker, Preface to Herschel's Astron.

(56) Arago, Annuaire, pour l'an 1836.

(57) Laplace, Système du Monde, p. 214.

five since Clairaut penned his suggestion. The masses of the several planets, upon which so much depends in these investigations, appear more or less imperfectly known. Laplace gives the following table of them, that of the sun being taken for unity.(58)

Mercury, ...	$\frac{1}{2025810}$
Venus, ...	$\frac{1}{405871}$
The Earth, ...	$\frac{1}{354936}$
Mars, ...	$\frac{1}{2546320}$
Jupiter, ...	$\frac{1}{1070,5}$
Saturn, ...	$\frac{1}{3512}$
Uranus, ...	$\frac{1}{17918}$

Pontecoulant, from the same unit, gives the several masses of the same planets thus:

Mercury, ...	$\frac{1}{1969706}$
Venus, ...	$\frac{1}{401839}$
The Earth, ...	$\frac{1}{356354}$
Mars, ...	$\frac{1}{2680337}$
Jupiter, ...	$\frac{1}{1053,924}$
Saturn, ...	$\frac{1}{3512}$
Uranus, ...	$\frac{1}{17918}$

These values, says our author, appear to us the most exact which have hitherto been obtained of the planetary masses. It will be observed that these two tables agree only in the masses of Saturn and Uranus; and of these Pontecoulant says it is very probable they need correcting, and that observations to determine that fact are in progress.(59) This was in 1834. Since that period this great geometrician has had cause to change his views in relation to some of these values. In calculating the perturbations of Halley's comet, he has made use of the following values, namely :(60)

Jupiter, ...	$\frac{1}{1048,69}$
Saturn, ...	$\frac{1}{3356,2}$
The Earth, ...	$\frac{1}{357500}$

These values, it will be seen, do not accord with those in either of the above tables. In the calculations here referred to, the action of Venus, Mercury and Mars was neglected as insensible. But a German geometrician, Rosenberg, on the contrary, has announced that the action of these three bodies, neglected as insensible by Pontecoulant, was sufficient to produce an acceleration of six days and one third in the return of Halley's comet.(61) With all these uncertainties respecting the larger known planets of our system, we must not forget that the masses of the four new planets are in no degree known, beyond the fact that, compared with some of the older ones, they are very small. But still, small as they are, they are probably capable of exercising an influence, according to relative position, distance, &c. upon bodies as easily disturbed as comets; and yet no sane attempt at a demonstration of the amount of such influence can be made, in the present state of our knowlege, for want of the necessary data. Brewster, in endeavoring to account for the lost comet of 1770, supposed, what indeed the subsequent investigations of Laplace have rendered wholly improbable, namely, that one of these new planets had arrested that body in its course, and added it to its own mass.(62) We have seen that the mass of Uranus, as well as of other planets, is unsettled: the number of its satellites is equally so. Herschel enumerates six. Laplace says powerful telescopes are necessary to perceive the second and the fourth, and that the published observations of Herschel upon the other four are too few to determine the elements of their orbits, or even incontestibly to assure us of their existence.(63) The younger Herschel says, of these satellites, "two undoubtedly exist, and four more have been suspected."(64)

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(58) Laplace, Système du Monde, p. 210.

(59) Théorie Analytique du Système du Monde, tome 3, p. 341, et suiv

(60) Connaissance des Tems, pour l'an 1838.

The immense periods of time consumed by some comets in performing their stated revolutions, are sufficient to convince us that the space beyond the orbit of the most distant planet now known to us, and within which moving bodies gravitate to our sun, is such that its extent could not easily be computed by any of our habitual methods. Whether planets still undiscovered by us are revolving there, in orbits beyond that of Uranus, is wholly unknown to us, and this ignorance of ours, while it continues, must involve in uncertainty the movements of all such comets as have their aphelions within the regions in question. The changes in the form and bulk of these bodies, in calculations so minute as have been attempted, to establish this theory of resistance, deserve attention. If, as appearances indicate, portions of the small masses of these bodies are occasionally removed from the nucleus or its vicinity to form the tails, which are sometimes extended to enormous lengths, while at others these portions of matter are reassembled around the nucleus, in whole or in part, these changes, by shifting the centre of gravity of the cometary body, must effect the action of foreign bodies thereon, and consequently influence the comet's motions. One other source of uncertainty, and one too which it would seem must forever remain such, in the movements of comets, is their action upon each other. To remove this source of errour no less would seem to be required than to identify every comet belonging to our solar system; to know the mass of each, the elements of the orbit it describes, as well as the elements of all those which perturbations may cause it hereafter to assume; and to weigh all its disturbing forces with such accuracy as to be able to determine its place, relatively to the sun and to every other body, at any given point of time. May not these numerous and active causes very well account, not only for the inequalities we have observed in the motions of comets, but even for much greater and more numerous ones, without the aid of a resisting medium? Some of these taken singly would, indeed, produce only slight results; but when it is considered that "in the immense ellipse described by a comet, the imperfection of analysis obliges the geometrician to follow that body step by step, as it were, without once losing sight of it for a single moment" throughout its revolutions, they may readily enough be supposed to cause greater deviations from calculated periods than "three one hundredths of a day," or less than forty-four minutes in a term of six years and three quarters. Pontecoulant deems it impossible, in the present state of science, to determine within one or two days, the instant of the passage of a comet through its perihelion; so very uncertain are the elements which astronomy furnishes for calculating their perturbations.(65)

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(61) Arago, Annuaire pour l'an 1836.

(62) Edinburgh Encyclopedia, article Comets.

(63) Système du Monde, p. 46.

(64) Astronomy, p. 282.

Having thus submitted the leading positions and arguments favourable to the theory of a resisting medium in the celestial regions, to detailed examination, the whole, according to the views we have taken, may be resolved into the following heads:

1st. That in periods of the most remote antiquity there prevailed a belief in the presence of ether in the celestial regions; but the proof, if any, upon which this belief was founded has not been preserved to us; nor are we better circumstanced, in reality, with regard to the basis of the faith of Alhazen, Tycho Brahe, Kepler, &c., in regard to this subject: but this belief we must not forget, was not coupled, so far as we have seen, with the theory of resistance.

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(65) Connaissance des Tems, pour l'an 1838, p. 119.

2d. That when the Cartesian theory arose, this ether, being an indispensable agent thereof, was every where believed in; not, indeed, as a resisting medium, but as a propelling one, which carried the planets forward in their orbits: this faith came to the ground with the doctrine of which it formed a part.

3d. When the laws of universal gravitation had exposed the errours of the Cartesian system, we find Newton still vaguely imagining of and concerning this substance, but in language so indistinct as not always to be definable; at one time supposing it to be the cause of gravity, and at other times, by its unequal density, mechanically giving direction to the motions of the heavenly bodies: the errour of these views is apparent.

4th. The ingenious arguments of Bossut, which took the prize of the French Academy, in 1762, were supposed to have well shown the resisting agency of this ether, in the acceleration of the moon's mean motion; and no doubts of the truth of this arose, until Laplace demonstrated that such acceleration is wholly due to the law of universal gravitation.

5th. That this ether has offered to the movements of comets a resistance which has rendered its agency appreciable. If the objections that have been offered against this are valid, they are much more than sufficient to destroy even its plausibility.

If the conclusions at which we have arrived, then, be correct, we have shown that the existence of this ethereal medium was for a long series of years believed in, without evidence known to us; that it has been, during another long series of years, even to the present day, accredited, also, upon different points of evidence, at different periods of time, but all which evidence has failed to sustain the fact of its existence; and that, therefore, to be hereafter adhered to, fresh evidences of its truth will be requisite to render it more than a mere hypothesis, or gratuitous assumption: not that its existence has been disproved; but only that confirmatory evidence of that existence no longer remains.

The predictions, therefore, that have pointed at the destruction of the solar system, through the agency of a resisting ether, may very well be discarded. Inequalities there certainly are, in the motions of the heavenly bodies; but all these are confined within narrow limits, and they constantly oscillate around a mean position. This ensures the stability and duration of the system. Many of them, indeed, extend through vast periods of time, for their accomplishment; but they are all the necessary consequences of the ascertained laws of gravity, and can never exceed their known limits. They constitute, in the sublime language of Pontécoulant, "immense pendulums of eternity, which beat the ages as ours do the seconds!"

Art. II.—*Sketch of the Early History of Count Rumford, in which some of the mistakes of Cuvier, and others of his biographers, are corrected;* by John Johnston.

Read before the Natural History Society of the Wesleyan University, June 30th, 1837.

The name of Count Rumford is familiar with every one who is at all acquainted with the progress of science and the arts, during the last half century. It is not however generally known, that Cuvier's Historic Eulogy[*] of this distinguished individual, and the short memoirs of him in our Encyclopedias and other standard works, so far at least as "they relate to that part of his life which was spent in America, are *very defective*, and in many respects *materially erroneous*."[†]

My attention was first drawn to this subject by observing the discrepancies in these memoirs with regard to the time and place of his birth, and the circumstances attending his departure from this country for Europe at the commencement of the American revolution.

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[*] Eloge Historique de Comte de Rumford lu dans le séance publique de L'Institute de France, le 9 Janvier, 1815.

[†] Hon. Josiah Pierce, of Gorham, Me., who is a nephew of Count Rumford, and to whom I am indebted for most of the information contained in this paper.

The entire confidence which is to be reposed in the statements of Mr. Pierce, will be seen from the following extract from a private letter of his, which he will pardon me for introducing.

"My father says he was half brother, to Benjamin Thompson,—afterwards Count Rumford,—having had the same mother, and was but three and a half years the Count's junior. They lived together in childhood, and my father was in constant correspondence with him up to the time of Rumford's death, in August, 1814. My grandmother lived in my father's house for seven years previous to her death, which occurred June 11th, 1811. The Countess Rumford was often a member of my father's family, and from the lips of the mother, brother, and daughter, I have the facts I am possessed of with regard to Rumford's early life."

Cuvier, in the paper referred to, says, "Benjamin Thompson, more commonly known by his German title of Count Rumford, was born in 1753, in the English colonies of North America, at a place then called Rumford, and at present Concord, in the state of New Hampshire." Again he says, "in the night of the 18th of April, 1775, the royal troops marched from Boston, and after having fought a first battle at Lexington, proceeded towards Concord; but, being presently assailed by a furious multitude, were obliged to betake themselves to their garrison. Mrs. Thompson's family was attached to the government by several important offices. Her husband, young as he was, had himself received from it some marks of confidence. His personal opinions, besides, led him to support the government. Thus it was natural that he should join the ministerial party with all the fervor of his age, and freely participate in its chances. He therefore returned to Boston with the army, and in such haste, that he was obliged to leave his wife at Concord. Having afterwards to move from place to place he never saw her again, nor was it until after a period of twenty years, that he met [in Europe] the daughter to whom she gave birth a few days after his departure."*

It is not at all surprising that Cuvier, who never was on this side of the Atlantic, should confound Concord, Massachusetts, with Concord, New Hampshire; but it will perhaps be a little difficult to imagine how he could mistake, as we shall presently see he did, on other points, concerning which he seems to express himself with such perfect confidence.

In the Edinburgh Encyclopedia likewise, we are told his birthplace was at Concord, New Hampshire; but in Rees' Cyclopedia it is said, "he was born at the village of Rumford in New England, in the year 1752."

The Encyclopedia Americana, correctly as to place, but erroneously as to time, says, he was born at Woburn, Mass., in the year 1752.

In a short biographical notice of Count Rumford in the Philosophical Magazine, for 1801, his birth-place is said to have been Rumford, Mass.†

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* American Journal of Science, &c. Vol. XIX, p. 28.

† Philosophical Magazine, Vol. IX, p. 135.

It has been my chief object in preparing this paper to correct some of those errors to which I have alluded, and in doing it, I will give a brief sketch of the early history of this distinguished personage. His later history will be found in the works to which reference has already been made.

Benjamin Thompson, better known by his German title of Count Rumford, was born at Woburn, Mass., sixteen miles from Boston, March 26th, 1753. His father and grandfather were farmers in moderate circumstances, and had long resided in Woburn. When he was about eight months old his father died, and in 1755, his mother married Mr. Josiah Pierce, grandfather of the gentleman whose name has already been introduced. A maternal uncle by the name of Joshua Simonds, who also resided in Woburn, was appointed young Thompson's guardian. He continued to live with his mother and father-in-law, from whom he appears to have received every necessary attention, and at the proper age was sent to the grammar school of his native town, then kept by Mr. John Fowle, a gentleman of a liberal education and esteemed an excellent teacher. Here he acquired considerable knowledge of reading, writing, arithmetic, and the Latin language. Subsequently he attended school in Byfield, Mass., and in March, 1764, he removed to Medford to attend the school of a Mr. Hill, then a celebrated teacher. In this place he remained nearly two years, and it was while attending school here that he one day surprised his instructor,* by bringing him the calculations of an eclipse, which he had made without assistance, and which proved to be singularly accurate.

Early in the year 1766, he left the school at Medford and went to live with a respectable druggist and apothecary of Salem, Mass., by the name of John Appleton, being then about thirteen years old. Here he was when the news of the repeal of the stamp act by the British parliament was received in this country, and produced such a sensation of joy throughout the colonies. Partaking largely of the same feeling himself, he undertook to prepare fireworks to be exhibited on the occasion; but in making a preparation of fulminating powder the composition accidentally took fire, and he was so badly burned and otherwise injured by the explosion, that his life was for some time despaired of. Having at length partially recovered, he was removed to his step-father's in Woburn; but before he was able to return again to Salem, the non-importation agreement entered into by the Americans had destroyed Mr. Appleton's business, and he was thus thrown out of employment. About this time, that is, when he was about fourteen years of age, he astonished his friends by producing a small piece of engraving which he had executed upon the brass cover of a pocket compass, with no other instrument than one of his own construction. The engraving, it is said, would not do discredit to a professed engraver at the present day, and is now in the possession of his relative in Maine.

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* By some it is said his instructor in mathematics, to whom he brought his calculations of the eclipse, was the Rev. Mr. Bernard. I have no other information with reference to it than that found in the books referred to.

The next winter,—the winter of 1768-69,—we find young Thompson teaching school in Wilmington, Mass., it being, I think, his first attempt of the kind; and the following summer he spent in Woburn, attending to the study of anatomy and physiology. In the winter of 1769, he was employed as a clerk in Boston, in the store of Mr. Hopestill Capen, who kept in Union street; but the business not suiting his inclination, he remained there but a few months. Mr. Capen once told his mother, that "he oftener found her son *under* the counter, with gimblets, knife, and saw, constructing some little machine, or looking over some book of science, than *behind* it, arranging the cloths or waiting upon customers." Here he was on the 5th of March, 1770, rendered memorable by the British massacre, as it has been called, and subsequently by the stirring eloquence of Dr. Warren in commemoration of the event. With other young men, whose feelings were powerfully excited by the atrocities of the British soldiery, he was with difficulty restrained from attacking them on the spot.

I may remark here, that Thompson's conduct on this occasion would not seem to favor the assertions of Cuvier and others, who affirm that, in the difficulties that led to the American Revolution, he was from the first, in principle and feeling, attached to the government party. But I shall have occasion to refer to this again.

In the spring of 1770, he returned again to Woburn, and during the summer, in company with his early and constant friend, the late Col. L. Baldwin, of Maine, he walked daily to Cambridge, a distance of nine miles, and back at night, to attend *as a charity scholar* the regular course of philosophical lectures in Harvard University. Speaking of these lectures at a late period of his life, he said he looked upon the few weeks he attended them, as the most delightful of his youthful life; they very much increased his stock of information and confirmed his taste for natural science.

In the autumn of this year (1770) he was invited to instruct a school in Concord, New Hampshire, then called Rumford; and here he closed his career as a schoolmaster in a manner not a little interesting, as in this place the train of circumstances seems to have originated, that eventually tore him from America and gave him to Europe. I allude to his marriage, an event always so productive of happiness or misery, and sometimes of both, as appears to have been the case in the present instance.

Mr. Thompson, soon after taking up his residence in Concord, became acquainted with Mrs. Sarah Rolfe, widow of Col. Rolfe, a lady of wealth and respectability; and their acquaintance resulted in their marriage when he was but nineteen years of age. Mrs. Rolfe was some ten or twelve years older than himself, and for the honor of her hand, Cuvier says he was indebted to his "belle figure, et des manières nobles et douces."

By the relatives of his wife, Thompson was introduced to Mr. Wentworth, then provincial governor of New Hampshire, who was much pleased with him, and bestowed upon him an unusual share of his attention. He soon gave him a major's commission in the militia of the province, and thus placed him at once over many older officers. This appointment must be admitted to have been exceedingly injudicious, but, as it was legal, it afforded no excuse for the feeling of envy and jealousy which was excited against Thompson, and from which all his subsequent difficulties appear to have originated previous to his leaving the country. It was whispered that Major Thompson was a tory; and such were the circumstances of the times, it is not surprising that many should give full credit to the rumor. We have the most satisfactory evidence, however, that up to this time at least, he was firmly attached to the cause of American liberty. As this is a point of some importance, I may be permitted to give my reasons a little in detail.

In the first place, Thompson had always professed strong attachment in principle and feeling to the popular cause, and his friends,* who espoused the same cause, ever had the utmost confidence in him.

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* In Capt. Parker's company, which was paraded on the green in Lexington upon the approach of the British troops on the morning of the 19th of April, 1775, there were four of the name of Simonds, the maiden name of Thompson's mother.

In the afternoon of the same day, among the killed was *Daniel Thompson* of Woburn.—*Everett's Orations*, pp. 523 and 524.

II. His conduct had uniformly been in accordance with his professions. His conduct in Boston on the 5th of March, 1770, has already been referred to,—he was there found sword in hand, among the most eager to attack those whom he considered the enemies of his country. Also, when he learned that his intimacy with Gov. Wentworth was made the occasion of suspicions with regard to the character of his political principles, he at once broke off the intercourse, and even resigned his commission in the militia and retired to his relatives in Woburn. He was present at the battle of Lexington; but whether he participated in the events of the day is to me unknown.

When, after the battle of Lexington, the American forces began to collect about Boston, we find him among them earnestly seeking employment, and on the best terms with the Massachusetts whig officers. When the battle of Bunker Hill occurred, he was with the American army at Cambridge; and on the arrival of Washington the 3d of the next month, to take charge as commander in chief, Thompson was favorably introduced to him by the officers, and would probably have obtained command of the American artillery had it not been for the opposition of some of the New Hampshire officers, who could not forget his former appointment over them by Gov. Wentworth. Jeremiah Gridley was finally appointed to the place.

III. He was formally tried before a committee of investigation, upon the general charge of being inimical to the cause of his country, and acquitted. Failing to obtain a place in the army he returned to Woburn, and such was the feeling of the populace at this time excited against him, that a mob once actually collected around the house in which he was and demanded him. The mob appear to have failed in their immediate object; but the insult his high spirit could not endure, and he at once applied to the committee of vigilance for the appointment of a court of inquiry to investigate his case. He was therefore arrested at his own request, and notice extensively given in the public papers of Massachusetts and New Hampshire, of the time and place appointed for his trial, and all who knew any thing against him were invited to be present and testify. The charge was the general one of being "unfriendly to American liberty." When the day of trial arrived, the committee assembled at the place appointed,—the meeting-house of the first parish in Woburn,—and took their seats before an overflowing house. Thompson managed his own defense; and though he could of course know but little previously of the *specific charges* that would be brought against him, he successively repelled them all, showing that they were based upon vague rumor, or had their origin in envy and jealousy. The committee gave this decision, but they still refused to give him a public acquittal which he demanded. The reason given was that it would give offense to his opponents, as it would be in a sense condemning them. They even refused to give him a copy of their proceedings for publication. This, Thompson very properly thought to be exceedingly illiberal and unjust treatment, and it is not surprising that his feelings were highly exasperated.*

If further proof of Thompson's political feelings previous to this time be wanting, we have the testimony of Col. Baldwin, at whose head quarters he remained while the American army was before Boston, who repeatedly said he knew his political views well, and that he was certain of his sincere attachment to the cause of his country. Another revolutionary officer of unimpeachable integrity, said to Thompson's brother,—or rather half brother,—the late Hon. Josiah Pierce, of Baldwin, Me., some years after the close of the war, that he knew Major Thompson well while he was with the American army at Cambridge in 1775, and that "he was certain his feelings were any thing but hostile to the cause of American liberty." He added further, that while the army was at Cambridge, on more than one occasion, Washington conferred with him upon important military affairs.

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* The following is an extract from the original report of the committee of vigilance and correspondence of the town of Woburn, before whom Thompson was tried in 1775, drawn up by one of their number, but which was not permitted to go before the public as Thompson demanded. After a statement of their authority and the prominent circumstances of the case, the committee say, "After a strict and impartial inquiry into Major Thompson's character and behavior, we do not find that *in any instance* he has shown a disposition unfriendly to American liberty, but that, on the contrary, his general conduct has evinced a contrary disposition, and we think he justly deserves the confidence, friendship, and protection of the public."

In a postscript it is added, "This may certify that when Major Thompson was examined before the committee of correspondence for the town of Woburn, (being brought before them on suspicion of being inimical to American liberties,) the affair of the return of four deserters from Concord in New Hampshire, to Boston, in which said Thompson was supposed to be instrumental, and also his conduct relative to the Concord donation,—sending a load of peas to Boston,—and an undue connection or correspondence with Gov. Wentworth, were matters *which were laid* to his charge against him, *which were thoroughly examined into*, and in every particular the committee received full satisfaction from said Thompson."

After his acquittal by the committee at Woburn, Thompson notwithstanding was still accused of "toryism" by the populace, and the mob again threatened him, till he at length formed the desperate resolution to quit forever his native country, and espouse the cause of her enemies! He had first, through the envy and jealousy of others, failed of promotion in the army, which appears to have been the highest object of his ambition, and to this had been added gross insult from the populace and injustice from public officers; and he unquestionably considered his personal safety in danger; but, trying as were the circumstances, his decision can hardly be justified. This act, in the eyes of his countrymen at least, must ever remain as a blemish upon his otherwise illustrious character. As remarked by Cuvier, it was unquestionably an evil to fight against his countrymen, but we should perhaps rather lament it as an evil, than impute to him blame.

Having determined to leave the country, Thompson communicated his design to no one but his brother before mentioned, who, taking him in a common horse-cart, started from Woburn in the night, and proceeded with him directly to Rhode Island, where he left him. Thompson soon made his appearance at Newport, and was taken on board the British ship of war Scarborough, in which he sailed for England; and even his mother for months did not know where he was.

The precise time of his departure from the country, I am not able to determine, but his biographers say he was sent to England immediately after the evacuation of Boston by the English troops, which occurred March 24th, 1776, to convey intelligence of that event.

In 1781, he sailed again for New York, where he raised a regiment of dragoons, and was in consequence promoted to the rank of Colonel, and remained connected with the British army till the close of the war, when he again went to Europe never to return. His subsequent brilliant course in the scientific world is well known. Though he had been persecuted from his native country, and been associated with those who for a time at least, were her enemies, yet he ever cherished an ardent affection for the land of his birth. In a letter to a relative written December, 1808, he says, "I never can forget the place of my birth, nor the companions of my early years." In another letter he remarks, "you cannot conceive how much I have the happiness of my native country at heart."

Nor did the American government on its part show an entire disregard for him, when in the year 1800, an important place was offered him, which however his engagements in Europe would not permit him to accept.

He ever took a lively interest in the American Academy of Arts and Sciences at Boston, "and in 1796 he established two biennial prizes of the value of about sixty guineas each, for the most important discoveries in light and heat; the one to be adjudged by the Royal Society of London,* and the other by the American Academy of Arts and Sciences."

Thompson was knighted by George III, immediately after his second arrival in Europe, in 1784, and for several years was known by the title of Sir Benjamin Thompson. Ten or twelve years afterwards, being then resident in Munich, he was created Count of Rumford, in reference to the place of his marriage, by the Elector of Bavaria, and various honors bestowed upon him, and a life pension of £1200.

After his return to Europe in 1784, most of his time was spent in the promotion of science and its application to the useful arts of life, in which, as is well known, he was eminently successful.

Count Rumford was not a learned man but a very close observer, and possessed great mechanical skill, and all his investigations appear to have been directed with a view to the discovery of *practical truths*, and directly benefitting mankind.

Among the imperishable honors that will ever attach to his name, is that of having been the first to suggest the plan of the Royal Institution of London, and of having selected young Humphrey Davy, then only twenty two years of age, to fill the chair of chemistry. This institution was founded in the year 1800, and in establishing it Count Rumford, in connection with other noble spirits in the scientific world, spent nearly a year and a half. Through it has been introduced to the world in the department of chemistry, in the short space of thirty five years, a Davy, a Brande, and a Faraday.

But it would not be in accordance with my design to pursue the history of this distinguished individual further. The last ten years of his life were spent at Auteuil, a small village near Paris. Though he had received many flattering marks of public favor, he had also

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* This medal was awarded by the Royal Society to

Prof. Leslie,	in	1804.	Dr. Wells,	in	1816.
M. Malus,	"	1812.	Dr. Brewster,	"	1818.
Sir H. Davy,	"	1814.	M. Fresnel,	"	1826.

Edinburgh Encyclopædia, Art. SOCIETY.

Whether the American Academy has ever made any award or not I am not informed.

learned something of its fickleness, which appears to have produced some effect upon his mind in souring it against human nature. In 1802, he married the widow of the celebrated Lavoisier, but the union proved unhappy and they soon separated. After this event the most of his time was spent in retirement, till his death which occurred August 21st, 1814.

Count Rumford left an only daughter, who was born, not as Cuvier affirms, at Concord, Mass., shortly after the battle of Lexington, from which her father had retired with the British troops to Boston, but at Concord, New Hampshire, Oct. 10th, 1774. She is still living, and possesses the title of Countess of Rumford, and a liberal pension. Much of her life has been spent in Europe, but she came to this country the last season on a visit to her friends, and I believe is now with them.

Art. III.—*On the Drawing of Figures of Crystals*; by James D. Dana, A. M., Assistant in the department of Chemistry, Geology and Mineralogy in Yale College.

1. The modern and improved methods of projecting the crystalline solids, have not, hitherto, been explained in any American publication; it is therefore presumed that the following exposition of this subject will not be unacceptable to the scientific public. The "Introduction to Crystallography" of H. J. Brooke,* is the only work in our language, which treats of crystallographic projection; and this work though valuable at the time of its publication, and highly reputable to its accomplished author, is necessarily behind a science, which, since its publication, has been so rapid in its advances. The principles embraced in the following pages, have been mostly drawn from the very complete and philosophical German treatise on crystallography by C. F. Naumann.†

2. The importance of accuracy in the delineations of crystals, is obvious. The edges of a crystal, as exhibited in a correct figure, constitute a language readily interpreted by the crystallographer. He reads, in them, the relations of each plane to the axes of the solid and with the preliminary knowledge of a few interfacial angles, (fre-

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* A familiar Introduction to Crystallography, by Henry James Brooke, 508 pp. 8vo, London, 1823.

† Lehrbuch der reinen und angewandten Krystrallographie, von Dr. Carl Friederich Naumann. Two vols. 8vo. Leipzig, 1832.

quently one is sufficient,) ascertains with perfect confidence, every other angle in the crystal. Consequently if these edges were incorrectly represented, the figure would be comparatively useless and unintelligible, and often would prove worse than useless, by leading to incorrect deductions.

Since these deductions depend on the parallelisms of edges, the following principle is of fundamental importance in the drawing of crystals; *edges which are parallel in the crystal should be represented in the figure as parallel.* Figures projected with this principle in view, though with no attempt to attain mathematical accuracy, will be valuable to the science. Yet a knowledge of mathematical crystallography, greatly facilitates the application of this principle. Crystals are often imperfect and the intersections of planes are indistinct, and consequently the exact limits of the planes and the direction of their mutual intersections cannot be observed. They are also frequently so much distorted that some planes are obliterated by the extension of others, and generally it is desirable to introduce in the figure, the plane or planes which may have been thus obliterated. These and other difficulties can only be surmounted by applying the principles of mathematical crystallography, which afford expressions for the planes indicating their exact situation.*

3. In the projection of crystals, the eye is supposed to be at an infinite distance, so that the rays of light fall from it on the crystal in parallel lines; otherwise the more distant parts of parallel edges should *converge,* as in the ordinary sketches of scenery. If parallel lines were drawn from the vertices of the solid angles of a crystal, to a board placed behind it, and the points thus formed on the board, were connected by straight lines, as in the crystal, a representation of the crystal would be formed, constructed according to the mode of projection employed in crystallography. The plane on which the crystal is projected, is termed the *plane of projection.* This plane may be at *right angles* with the vertical axis, may pass *through* the vertical axis, or may intersect it at an *oblique angle.* These different positions give rise, respectively, to the *horizontal, vertical* and

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* With but an *imperfect* knowledge of these principles, it becomes a simple process to project the axes of their relative dimensions and exact obliquity, and after this preparation, to lay off with accuracy, the situation and intersections of the various secondary planes. Indeed, the *projection of the axes* in each of the systems of classification excepting perhaps the clinate, may be easily understood without any acquaintance with mathematical crystallography, and the subsequent construction of the secondary forms requires only a familiarity with the system of crystallographic notation.

oblique projections. The rays of light may fall *perpendicularly* on the plane of projection, or may be *obliquely* inclined to it; in the former case the projection is termed *orthographic*, in the second *clinographic*. In the horizontal position of the plane of projection, the projection is always orthographic. In the other positions, it may be either orthographic or clinographic. It has been usual to give the plane of projection an oblique position, and to use the orthographic mode of projection. It is however preferable to employ the vertical position and clinographic projection, and this method will be elucidated in the following remarks.

PROJECTION OF THE PRIMARY FORMS.

4. The projection of the axes of a crystal, is the first step preliminary to the projection of the crystal itself. It will be more convenient, to illustrate first the projection of the axes in the monometric primaries, which are equal and intersect at right angles. The projection of the axes in the other classes, may be obtained by varying the lengths of the projected monometric axes, and also, when oblique, their inclinations.

5. 1. *Monometric system.**—When the eye is directly in front of a face of the cube, neither the sides nor top of the crystal are visible, nor the secondary planes that may be situated on the intermediate edges. On turning the crystal a few degrees from right to left, a side lateral plane is brought in view, and by elevating the eye slightly, the terminal plane becomes apparent. Half the planes on the crystal are now visible, and consequently this is a convenient

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* The systems of crystallization at present recognized, are seven in number.

The *Monometric* includes the cube, regular octahedron and dodecahedron, the three crystallographic axes of which are of *one* kind, and intersect at right angles.

The *Dimetric* system includes the right square prism and square octahedron, the axes of which are rectangular and of *two* kinds, the vertical being unequal to the lateral.

The *Trimetric* system includes the right rectangular and rhombic prisms, and the rectangular and rhombic octahedrons, the axes of which primaries are rectangular, and *unequal*, or of *three* kinds.

The *Monoclinate* system includes the right rhomboidal prism and the oblique rhombic prism, in which, two of the intersections of the axes are rectangular and *one oblique*.

The *Diclinate* system includes the oblique rectangular prism, in which one of the intersections of the axes is rectangular and *two oblique*.

The *Triclinate* system includes the oblique rhomboidal prism, in which the *three* intersections of the axes are *oblique*.

The *Tetraxonal* system includes the rhombohedron and hexagonal prism, which contain four axes, viz. three horizontal and one vertical.

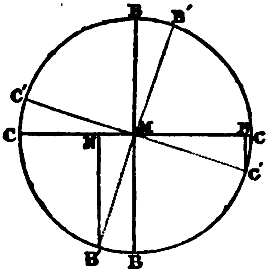
position for projecting it. In the following demonstration the angle of revolution is designated δ, and the angle of the elevation of the eye, ε. Fig. 1. represents the normal position of the horizontal axes, supposing the eye to be in the direction of the axis *BB*; *BB* is seen as a mere point, while *CC* appears of its actual length. On revolving the whole through a number of degrees equal to *BMB′* (δ) the axes have the position exhibited in the dotted lines. The projection of the semiaxis *MB* is now lengthened to *MN*, and that of the semiaxis *MC* is shortened to *MH*. Since the angle $HMC' = MB'N = \delta$, $MH = \cos\delta$ and $MN = \sin\delta$; and if the ratio of the projected axes be as

$$r : 1,\ MH : MN :: \cos\delta : \sin\delta :: r : 1;$$

$$\therefore \cos\delta = r\sin\delta,$$

and consequently, $\cot\delta = r$.

Fig. 1.



If the eye be elevated, the lines *B′N*, *BM* and *C′H* will be projected respectively below *N*, *M* and *H*, and the lengths of these projections (which we may designate *b′N*, *bM* and *c′H*) will be directly proportional to the lengths of the lines *B′N*, *BM* and *C′H*. Now $B'N = \cos\delta$, and *bM*, the projection of *BM*, $= \tan\varepsilon$; consequently,

$$BM (=1) : \tan\varepsilon :: \cos\delta\ (B'N) : b'N \text{(the projection of } B'N).$$

Hence, $b'N = \tan\varepsilon \cos\delta$.

In the same manner we find $c'H = \tan\varepsilon \sin\delta$.

If the relation of *b′N* to *MN* (= the first projection = $\sin\delta$) equals $\frac{1}{s}$,

$$\tan\varepsilon \cos\delta\ (b'N) = \frac{1}{s}\sin\delta;$$

consequently, $\tan\varepsilon \cot\delta = \frac{1}{s}$:

and finally, since $\cot\delta = r$,

$$\cot\varepsilon = rs.$$

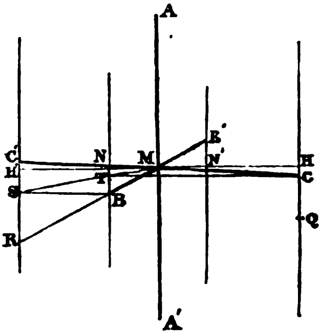
6. The preceding demonstration affords the following simple method of projecting the monometric axes; *r* is supposed to be given equal to 3, and *s* equal to 2.

1. Draw two lines *AA′*, *H′H* (fig. 2.) intersecting one another at right angles. Make $MH = MH' = b$. Divide *HH′* into *r* parts, and through the points, *N*, *N′*, thus determined, draw perpendicu-

lars to HH'. On the left hand vertical, set off, below H', a part $H'R$, equal to $\frac{1}{s}b=\frac{1}{s}H'M$; and from R draw RM, and extend the same to the vertical N'. $B'B$ is the projection of the front horizontal axis.

2. Draw BS parallel with MH', and connect S, M. From the point T in which SM intersects BN, draw TC parallel with MH. A line (CC') drawn from C through M, and extended to the left vertical, is the projection of the side horizontal axis.

Fig. 2.



3. Lay off on the right vertical, a part HQ equal to $\frac{1}{r}$ MH, and make $MA=MA'=MQ$; AA' is the vertical axis.

Proof. 1. By construction, MN (the first projection of the semiaxis BM, N being in the line HH') : MH (the first projection of MC) : : 1 : r, which is the ratio required in the preceding demonstration. Again, by construction, $BN : NM :: RH' : H'M :: 1 : s$, therefore BN (the second projection of BM) $=\frac{1}{s}$ MN, which is also the ratio required above. BB' is therefore correctly the front horizontal axis.

2. From the method of construction,

$$H'S(=BN) : TN(=HC) :: H'M : NM :: \cos\delta : \sin\delta.$$

Therefore HC is the true depression of the axis CC'; for in the preceding demonstration, the depressions were proved to equal respectively $\tan\varepsilon\cos\delta$ and $\tan\varepsilon\sin\delta$, and consequently to have the ratio of $\cos\delta : \sin\delta$.

3. $MH=\cos\delta$ and HQ is the sine of the same angle. MQ is therefore the radius in the same circle (fig. 1.) and equals the vertical semiaxis; for the position of the eye does not change the apparent length of this axis, since it is situated in the plane of projection.

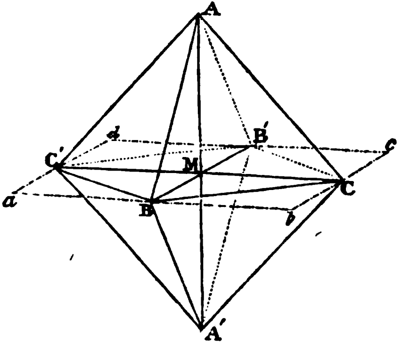
AA', $C'C$, BB', are therefore the projected monometric axes.

The values of r and s, commonly taken are, $r=3$, $s=2$, in which case, δ : 18° 26′ and $\varepsilon=9° 28'$. It is not unusual to give s the value 3, in which case $\varepsilon=6° 20'$. This affords a narrower terminal plane.

7. The regular octahedron may now be drawn, by connecting the extremities of the horizontal axes, and then uniting them by right lines with the points A, A', as in fig. 3. If lines be drawn

through the points *B* and *B′*, parallel with *CC′*, and through *C*, *C′*, parallel with the axis *BB′*, a plane figure *abcd* is formed, which is a horizontal section of the cube. Through the points *a*, *b*, *c*, *d*, draw lines parallel with the vertical axis *AA′*, and extend them each side of these points, to a distance equal to the vertical semi-axis *MA*. By connecting the upper and also the lower extremities of these perpendiculars by lines parallel with the lines *ab*, *bc*, *cd*, *da*, the figure will represent a cube.

Fig. 3.



The cube may also be projected by drawing lines from *M* to the center of each edge of the octahedron, and then extending these lines to double their length. Their extremities are the vertices of the angles of the cube; and by connecting them a representation of the cube is formed.

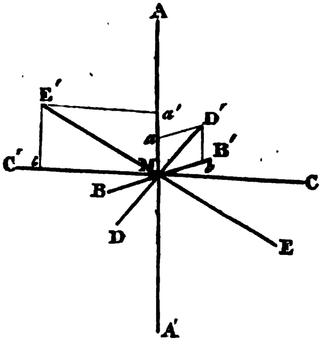
8. *Dimetric System.*—In the dimetric system of crystallization, the vertical axis is of varying dimensions, while the horizontal axes are equal as in the monometric system. The vertical axis may be made to correspond to the dimensions in a dimetric crystal, by laying off on *MA* and *MA′*, (taken as units,) extended if necessary, a line equal to $\frac{a}{b}$; or if *b*, the horizontal axis of the prism, $=1$, the line should equal *a* (the vertical axis) merely. After determining thus the points *A″*, *A‴*, the dimetric octahedron may be formed in the same manner as the regular octahedron above described, except that the points *A″*, *A‴* should be substituted for *A*, *A′*. The method of describing the cube, already explained, may be employed also for the right square prism. Another right square prism may be represented by drawing lines parallel with the vertical axis, through the extremities of the horizontal axes, making them equal to the vertical axis, and uniting their extremities. Also another square octahedron may be constructed by connecting the points *a*, *b*, *c*, *d*, with the extremities of the vertical axis.

9. *Trimetric System.*—The monometric axes may be adapted to trimetric forms as follows: if the axis $b=1$, lay off *MA″* and

MA''' equal to a, and MC', MC'' equal to c: if $c=1$, make MB'', MB''', equal to b. By connecting the extremities of the axes, as already explained, the rhombic octahedron may be constructed. The rectangular prism may be projected, in the same manner as the cube; the rhombic prism in the same manner as the second square prism just described; and the rectangular octahedron, in the same manner as the second dimetric octahedron explained in the last section.

10. *Monoclinate System.*—The axes a and b in the monoclinate system are inclined to one another at an oblique angle$=\gamma$. To project this inclination, and thus adapt the monometric axes to a monoclinate form, lay off on the axis MA, $Ma=MA\ \cos\gamma$, and on the axis BB' (before or behind M according as the inclination of b on a, in front, is acute or obtuse) $Mb=MB\times\sin\gamma$. From the points b and a, draw lines parallel respectively with the axes AA' and BB' and from their intersection D', draw through M, $D'D$, making $MD=MD'$. The line DD' is the front lateral axis, and the lines AA, $C'C$, DD' represent the axes in a monoclinate solid in which $a=b=c=1$. The points a and b and the position of the axis DD' will vary with the angle γ. The relative values of the axes may be given them as above explained; that is, if $b=1$, lay off in the direction of MA and MA' a line equal to a, and in the direction of MC and MC' a line equal to c, &c.

Fig. 4.



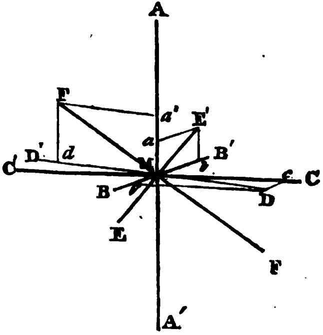
The right rhomboidal prism may be projected in the same manner as the cube or right rectangular prism, and the oblique rhombic prism, in the same manner as the right rhombic prism.

11. *Diclinate System.*—In the diclinate system, the vertical sections through the horizontal axes intersect one another at right angles, as in the preceding system, but the inclination of a to b (γ) and a to c (β) are each oblique. This obliquity may be given the monometric axes as follows: Lay off on MA, (fig. 4,) $Ma=MA\times\cos\gamma$, and on the axis BB' (brachydiagonal), $Mb=MB'\times\sin\gamma$. By completing the parallelogram $MaD'b$, the point D' is determined. Make $MD=MD'$; DD' is the projected brachydiagonal. Again lay off on MA, $Ma'=MA\times\cos\beta$, and on MC', to the left, $Mc=MC'\times\sin\beta$. Draw lines from a' and c parallel to MC' and MA; E', the

intersection of these lines, is one extremity of the macrodiagonal; and the line $E'E$, in which $ME=ME'$, is the macrodiagonal. AA' DD', EE' are the axes in a diclinate form in which the axes are equal. From the observations on the preceding systems of crystallization, the method to be employed in giving the axes their relative values in a particular diclinate form, is sufficiently obvious. The construction of the oblique rectangular prism is analogous to that of the cube.

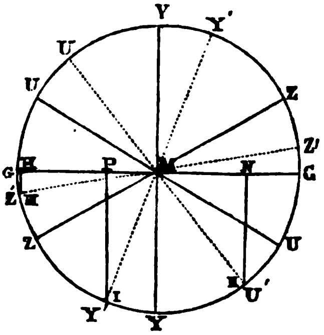
12. *Triclinate system.*—The vertical sections through the horizontal axes, in the triclinate system, are obliquely inclined; also the inclination of the axis a to each axis b and c, is oblique. In the adaptation of the monometric axes to the triclinate forms, it is therefore necessary, in the first place, to give the requisite obliquity to the mutual inclination of the vertical sections, and afterwards, to adapt the horizontal axes, as in the diclinate system. The inclination of these sections we may designate A, and as heretofore, the angle between a and b, γ, and a and c, β. BB' is the analogue of the brachydiagonal and CC' of the macrodiagonal. An oblique inclination may be given the vertical sections, by varying the position of either of these sections. Permitting the brachydiagonal section $ABA'B'$ to remain unaltered, we may vary the other section as follows:

Fig. 5.



Lay off on MB, $Mb'=MB\times\cos A$, and on the axis $C'C$, (to the right or left of M, according as the acute angle A is to the right or left) $Mc=MC\times\sin A$; completing the parallelogram $Mb'Dc$, and drawing the diagonal MD, extending the same to D' so as to make $MD'=MD$, we obtain the line DD'; the vertical section passing through this line is the correct macrodiagonal section. The inclination of a to the new macrodiagonal DD', is still a right angle; as also the inclination of a to b, their oblique inclinations may be given them by means of the same formulas employed in the diclinate system, except that the axis $D'D$ is to be substituted for $C'C$. The vertical axis AA' and the horizontal axes EE' (brachydiagonal) and FF' (macrodiagonal) thus obtained, are the axes in a triclinate form in which $a=b=c=1$. Different values may be given these axes according to the method heretofore illustrated.

Fig. 6.



13. *Tetraxonal system.*—This system of crystallization includes those forms which contain three equal horizontal axes, at right angles with the vertical. The normal position of the horizontal axes is represented in fig. 6. The eye, placed in the line of the axis *YY*, observes two of the semiaxes, *MZ* and *MU*, projected in the same straight line, while the third *MY* appears a mere point. To give the axes a more eligible position for a representation of the various planes on a tetraxonal solid, we revolve them from right to left through a certain number of degrees, δ, and elevate the eye at an angle ϵ. The dotted lines in the figure represent the axes in their new situation, resulting from a revolution through a number of degrees equal to $\delta = YMY'$. In this position the axis MY' is projected upon *MP*, MU' upon *MN* and MZ' on *MH*. Designating the intermediate axis I, that to the right II, that to the left III, if the revolution is such as to give the projections of I and II, the ratio of 1 : 2, the relations of the three projections will be as follows: I : II : III = 1 : 2 : 3.

The projection of

I $= \sin \delta$.

II $= \sin (60^\circ - \delta)$, for $MU'N = U'MY = YMU - UMU' = 60^\circ - \delta$.

III $= \sin (60^\circ + \delta)$.

From these equations and the above ratios, it follows that,

$$\sin (60^\circ + \delta) = \sin (60^\circ - \delta) + \sin \delta;$$
$$\sin (60^\circ - \delta) = 2 \sin \delta;$$
$$\sin (60^\circ + \delta) = 3 \sin \delta.$$

Consequently since (Trig. Anal.)

$$\sin (60^\circ + \delta) = \sin 60^\circ \cos \delta + \sin \delta \cos 60^\circ = 2 \sin \delta;$$
$$\sin (60^\circ - \delta) = \sin 60^\circ \cos \delta - \sin \delta \cos 60^\circ = 3 \sin \delta.$$

Adding the equations we obtain

$$2 \sin 60^\circ \cos \delta = 5 \sin \delta;$$

Whence $\tan \delta = \dfrac{2 \sin 60^\circ}{5} = \dfrac{2\sqrt{\frac{3}{4}}}{5} = \dfrac{\sqrt{3}}{5};$

$$\therefore \cot \delta = 5\sqrt{\tfrac{1}{3}}.$$

From this equation we may deduce

$$\sin \delta = \sqrt{\tfrac{3}{28}};$$
$$\therefore \delta = 19^\circ\, 6'\, 24''.$$

If the eye be elevated above the horizontal plane, the lines PY', NU', HZ' will be projected below GG. The lengths of these projections are in direct ratio to the lines projected.

To obtain the values of PY', NU', HZ', we observe that

$$PY' = \cos\delta;\ NU' = \cos(60^\circ - \delta);\ HZ' = \cos(60^\circ + \delta).$$

Whence, since $\cos = \sqrt{(R^2 - \sin^2)}$,

$$\cos\delta = \sqrt{(1 - \sin^2\delta)} = 5\sqrt{\tfrac{1}{28}};$$
$$\cos(60^\circ - \delta) = \sqrt{(1 - 4\sin^2\delta)} = 4\sqrt{\tfrac{1}{28}};$$
$$\cos(60^\circ + \delta) = \sqrt{(1 - 9\sin^2\delta)} = \sqrt{\tfrac{1}{28}}.$$

From these equations, the following relations result:

$$PY' : NU' : HZ' :: 5 : 4 : 1,$$

which, therefore, is also the ratio of the projections of these lines below GG consequent on an elevation of the eye at any angle ε.

If the second projection of the semiaxis I $(y'P)$, $= \frac{1}{s}$ part of PM (the first projection),

$$\cot\varepsilon = s\cot\delta = 5\,s\sqrt{\tfrac{1}{3}}.$$

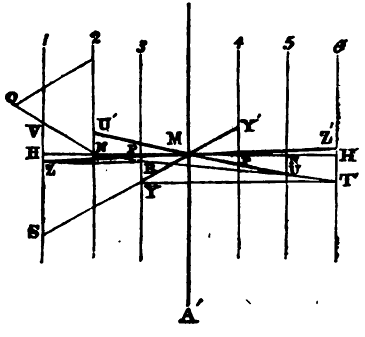
For if PY' be made radius in the two triangles $PY'y'$ and PYM, we shall have $Py' = \tan\varepsilon$, and $PM = \tan\delta$. But $Py' : PM : 1 : s$; consequently

$$\tan\varepsilon : \tan\delta :: 1 : s;$$
$$\tan\varepsilon = \frac{\tan\delta}{s};$$
$$\therefore \cot\varepsilon = s\cot\delta.$$

In general it is most convenient to assume 2 as the value of s; then $\varepsilon = 9^\circ\ 50'$. If $s = \sqrt{3}$, $\varepsilon = 11^\circ\ 18{\cdot}5'$.

14. *Projection of the axes.*—The above demonstration affords a method of projecting the tetraxonal axes, which is similar to the method in the monometric system. We may assume $r=3$, $s=2$.

Fig. 7.



1. Draw the lines AA, HH at right angles with, and bisecting each other. Let $HM = b$, or $HH = 2\,b$. Divide HH into six parts by vertical lines. These lines including the left and right hand verticals may be numbered from one to six as in the figure. In the first vertical, below H, lay off $HS = \frac{1}{s}\,b$, and from S

draw a line through M to the fourth vertical. YY' is the projection of the axis I.

2. From Y draw a line to the sixth vertical and parallel with HH. From T the extremity of this line, draw a line to N in the second vertical. Then from the point U in which TN intersects the fifth vertical, draw a line through M to the second vertical; UU' is the projection of the axis II.

3. From R, where TN intersects the third vertical, draw RZ to the first vertical parallel with HH. Then from Z draw a line through M to the sixth vertical: this line ZZ' is the projection of the axis III.

4. For the vertical axis, we observe in fig. 6. that $Z'H = \sin(30^\circ - \delta) = \cos(60^\circ + \delta)$; also $MH = \cos(30^\circ - \delta) = \sin(60^\circ + \delta)$. But $\sin(60^\circ + \delta) : \cos(60^\circ + \delta) = 3\sqrt{3} : 1 = 3 : \tan 30^\circ$.

Consequently $\frac{1}{3} MH : Z'H :: 1 : \tan 30^\circ$, or $Z'H$ equals tan 30°, in a triangle whose base is $\frac{1}{3} MH$. If therefore we lay off from N on the second vertical (fig. 7.) a line of any length and construct upon this line an equilateral triangle, one side NQ of this triangle will intersect the first vertical at a distance, HV, from H, corresponding to $Z'H$ in fig. 6.; for in the triangle NHV, the angle HNV is an angle of 30° and $HN = \frac{1}{3} MH$. MV is therefore the radius of the circle (fig. 6.) Make therefore $MA = MA' = MV$; AA' is the vertical axis, and YY', UU', ZZ' are the projected horizontal axes.

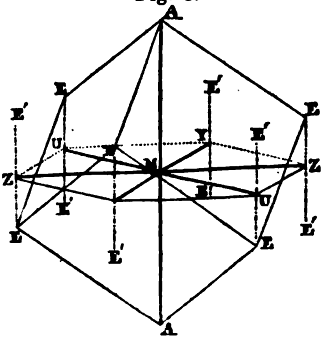
The explanation of this construction, is obvious from the preceding demonstration, and from the remarks under the monometric system.

15. The vertical axis has been constructed equal to the horizontal axes. Its length in the several tetraxonal primaries may be laid off according to the method sufficiently explained. If lines be drawn through the extremities of the horizontal axes, parallel with the vertical axis, and the parts above and below be made equal to the vertical semiaxis, their extremities will be the vertices of the angles of a *hexagonal prism*, and by connecting them, we obtain the projection of this solid. A double hexagonal pyramid, the isosceles dodecahedron, may be projected by connecting the extremities of the horizontal axes with each other and also uniting them with the extremities of the vertical axis. By drawing lines through the extremities of each horizontal axis, parallel to a line connecting the extremities of the other two axes, a plane hexagonal figure will be obtained which is the section of a hexagonal prism diagonal with the one above referred to; and by connecting the angles of this

hexagonal plane with the extremities of the vertical axis, a *second* isosceles dodecahedron is projected.

16. To construct a rhombohedron, lay off verticals through the extremities of the horizontal axes, and make the parts, both above and below these extremities, equal to the third of the vertical semiaxis, (fig. 8.) The points E, E, E′ E′ &c. are thus determined; and if the extremities of the vertical axis be connected with the points E or E′, rhombohedrons, in different positions, m R or $-m$ R, will be constructed.

Fig. 8.



Delineation of Secondary Planes on the Primary Forms.

17. Previous to drawing the secondary planes on a primary, it becomes necessary to determine the direction of the intersections of these planes with the primary faces, and also in most cases, with other secondary planes. The principles of analytical geometry have afforded Naumann formulas for these intersections; but it would be giving this article too great an extension to enter into a full discussion of this method of determining intersections. It is in general sufficient to employ the method of construction. This method has been fully explained by Brooke, but in connection with the Abbé Haüy's system of crystallographic notation.

In the employment of the plan of construction, the projection of the prism $0P.\infty P\infty$, is the most convenient preliminary step; that is, the cube in the monometric system, right square prism in the dimetric system, the rectangular prism in the trimetric, the right rhomboidal in the monoclinate, and the prism $0P.\infty\bar{P}\infty.\infty\breve{P}\infty$, in the diclinate and triclinate systems.* This is advisable because in these forms the lateral edges are equal and parallel to the vertical axis, and the basal edges, to the horizontal axes; and consequently in laying off the different planes, these edges may be substituted for the axes.

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* The system of notation here adopted, is that employed by Naumann. It will be found explained and illustrated in my system of Mineralogy.

18. Suppose for example the right rectangular prism has been projected, (fig 9.) and it is required to place on its angles the plane 2P, whose parametric ratio is 2 : 1 : 1. Since 2 refers to the vertical axis, we lay off on the lateral edge (*e*) twice as many parts of this edge as of each of the terminal edges (ē and ĕ.) Consequently, by taking a point in the edge *e* distant from *a*, ½ the length of *e*, and a point in each ē and ĕ, ¼ their respective lengths, and then joining these points, the conditions will be complied with, and the plane 2P will be constructed. If the plane to be introduced were $4\bar{P}2$ the parametric ratio of which is 4 : 2 : 1, (in which 4 refers to the vertical axis and 2 to the longer horizontal,) we should in the same manner mark off 4 parts of *e*, 2 of ē and 1 of ĕ; if the plane were $4\breve{P}2$, (in which 2 refers to the shorter horizontal axis,) 2 parts of ĕ should be laid off, and 1 of ē. By connecting the points thus determined, the plane $4\bar{P}2$ or $4\breve{P}2$ would be delineated. If the plane were $2\bar{P}\infty$ (2 : ∞ : 1), which represents a plane on the longer terminal edge, 2 parts of *e* should be laid off, and 1 of ĕ; from the determined points in e and ĕ, lines should be drawn to the opposite edges parallel with the edge ē, and by connecting the extremities of the lines thus drawn, the desired representation of a plane $2\bar{P}\infty$ would be completed. The same should be repeated on all the similar edges. This will suffice to illustrate the manner of substituting the edges for the axes, and also the method of delineating single planes.

19. The manner of determining the intersections of planes, we may illustrate by an example. Suppose it were required to place the planes P, 2P, $4\breve{P}2$ and $2\bar{P}2$ on a right rectangular prism. Two rectangular prisms should first be accurately projected by the method which has been explained. One, of a size which may be considered convenient for a representation of the crystal, drawn with light pencil marks; the other of larger dimensions, for the purpose of determining the direction of the intersections; these intersections when determined are to be transferred to the smaller figure. On fig 9, we may first lay down the plane P, by drawing lines connecting the centers of the three edges about the angle. These lines are necessarily parallel to the diagonals of the three faces; the triangle *mno* is therefore the plane P. By connecting the points *m*, *b*, *n*, the plane 2P is constructed; for the plane *mbn* cuts off 2 parts of *e* to 1 of each ē and ĕ, as the expression 2P requires. To lay off $4\breve{P}2$ (4 : 1 : 2.) Let the whole edge *ab* represent 4; then *an* (½ of ĕ) will equal 2

parts on the edge ĕ, and *ap* ($\frac{1}{4}$ of ē) will equal 1 part on ē, agreeably to the expression 4P̆2; *npb* is therefore the plane 4P̆2. The perimeters of the planes *npb* (4P̆2) and *nmo* (P) intersect one another in the points *n* and *α*; consequently the line of intersection, between these two planes must be situated between these points, and therefore the direction of the intersection of P and 4P̆2 is *n α*.

Fig. 9.

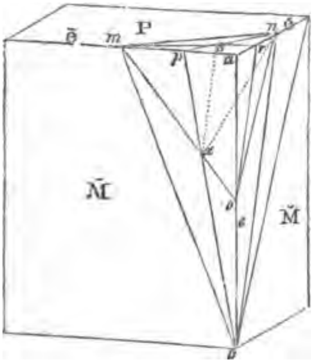
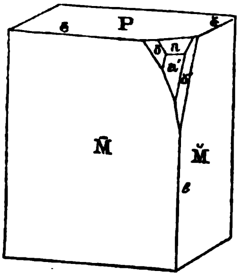


Fig. 10.



The planes *nmb* (2P) and *npb* (4P̆2) intersect in the line *nb*, and therefore the intersection of 2P and 4P̆2 is in the direction of *nb*.

Again, the intersection of P and 2P has the direction *mn*.

We may next lay off the plane 2P̄2, (2 : 2 : 1,) which may be constructed by marking off 2 parts on each *e* and ē and 1 part on ĕ. Such a plane is *mro*, since *ao*$=\frac{2}{4}$ *e*, *am*$=\frac{2}{4}$ ē, and *ar*$=\frac{1}{4}$ ĕ. Therefore the intersection of *mro* (2P̄2) with *mno* (P) has the direction of the common line *mo*.

The perimeters of the planes *mro* (2P̄2) and *npb* (4P̆2) intersect in the points *α* and *β*. If therefore these planes formed an edge of intersection it would have the direction of the line *αβ* or *ro*.

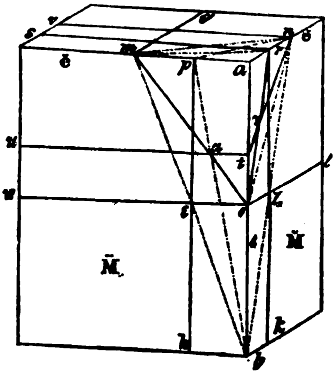
The line *ro* of the plane *mro* (2P̄2) is parallel to *nb*, of the plane *mnb* (2P); the intersections of 2P̄2 and 2P would therefore be parallel with these lines. In this manner all the mutual intersections of these and other planes may be obtained.

Fig 10 exhibits these planes in their respective positions as above determined. The planes may be lettered as in the figure; *mno*=a, *mnb*=a′, *mro*=ō, *npb*=ŏ′. The edges a : P and a : a′ were made parallel with *mn* (fig. 9.) The intersection of P with ō has the direction *mr*, that of P with ŏ′, the direction of *np*. The intersections of a, ō, M̄ are parallel with *mo;* those of a′, ŏ′, M̆, have the direction *bn*, as determined above. The edge a : ŏ′ is drawn in the direction *nα*, explained above as the intersection of *npb* and *nmo*. Finally the edge M̄ : a′ is drawn parallel with *mb*, and the edge M̄ : ŏ′, parallel with *pb*, which in fig. 9, is obviously the intersection of *pbn* with M̄. The planes ō and ŏ′ do not meet; were the plane a′ wanting, their intersection would have been drawn parallel with *αβ* or parallel with the edge a′ : ŏ′.

20. In this manner a sketch of a crystal may be made or rectified, or a figure may be drawn, whose prototype has not been observed. The crystallographic expressions however, do not indicate the size of the planes. The edge M̆ : ŏ′ might have been so drawn as not to have formed an intersection with the plane P. Again, these secondary planes might have been so extended, that in connection with the corresponding planes on the other angles, they should obliterate mostly or entirely the primary faces. The intersections of the planes would not however be changed in direction. There would be new intersections of planes on opposite parts of the same primary face, which it would be necessary to determine in the above manner.

21. We may now add the planes ⅔P̄∞, 2P̄∞, P̆∞, and ∞P; the two former are replacements of the longer terminal edge ē, the third is situated on the shorter edge ĕ, and the last is a replacement of a lateral edge. We may also suppose that ⅔P̄∞ meets the planes a and ō; 2P̄∞, the plane ō; P̆∞ the planes a and ŏ′, and ∞P, the planes a′ and ŏ′. It is therefore necessary to determine the direction of these intersections. For this purpose fig. 9 is redrawn (fig. 11) to avoid confusion from the multiplicity of similar lines, (this would not be required in practice,) and the lines in the preceding figure, not including the new planes, are here dotted.

Fig. 11.



The plane *ntuv* is so drawn that *an* equals ½ĕ and *at*=⅔ of ½*e*, which fulfills the conditions for the plane ⅔P̄∞ (⅔ : ∞ : 1). Again *srow* is the plane $2\bar{P}\infty$ (2 : ∞ : 1); for it cuts off $\frac{2}{4}$ of *e* and $\frac{1}{4}$ of ĕ, or 2 parts of *e* to 1 of ĕ.

The perimeters of the planes *vntu* ($\frac{2}{3}\bar{P}\infty$) and *mno* (P) intersect in the points *n* and *α*; the intersections of $\frac{2}{3}\bar{P}\infty$ with P has therefore the direction *αn*, and is parallel with the edge a : ŏ′ in figure 10.

The perimeters of the planes *vntu* ($\frac{2}{3}\bar{P}\infty$) and *mro* ($2\bar{P}2$), intersect in the points *α* and *γ*; and a line from *α* to *γ* marks the direction of the edge between the planes $\frac{2}{3}\bar{P}\infty$ and $2\bar{P}2$.

The perimeters of the planes *srow* ($2\bar{P}\infty$) and *mro* ($2\bar{P}2$), coincide in the line *ro*. The intersection of $2\bar{P}\infty$ and $2\bar{P}2$ has therefore the direction *ro* and is parallel with the edge ō : a′ in fig. 10.

Again, the plane *gmol* represents $\breve{P}\infty$, (1 : 1 : ∞) for it cuts off equal parts of the edges *e* and ē. The perimeters of the planes *gmol* and *nmo* (P) coincide in the line *mo*; their intersection is therefore parallel to this line, or to the edges a : ō and ō : M̄, fig. 10.

The perimeters *gmol* and *npb* ($4\breve{P}2$) intersect in the points *α* and *ζ*; a line from *α* to *ζ* therefore marks the direction of the edge between $\breve{P}\infty$ and $4\breve{P}2$ (ŏ′).

Again, the plane *prkh* is the projection of ∞P (∞ : 1 : 1), for it cuts off equal portions of ē and ĕ, and is parallel with the lateral edge. The perimeters *prkh* (∞P) and *mbn* (2P) intersect in the points *ε* and *ζ*; a line between these points is parallel with *mn*. The intersection of these planes will therefore be parallel with *mn*, or the edge a : a′ (fig. 10.)

The perimeters *prkh* (∞P), and *pnb* ($4\breve{P}2$) intersect in the points *p* and *ζ*. A line drawn from *p* to *ζ* determines therefore the intersection of ∞P and $4\breve{P}2$ (ŏ′).

Fig. 12.

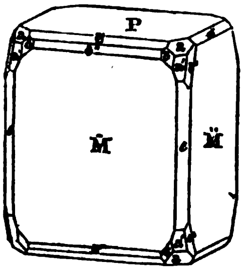


Fig. 13.

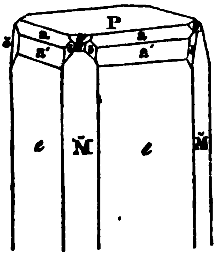


Fig. 12, contains these additional planes laid down according to the above deductions. The edge a : ē′ ($\frac{2}{3}\bar{P}\infty$) is parallel with the edge a : ŏ′; the edge ē′ : ō has the direction *αγ*; the edge ē″($2\bar{P}\infty$) : ō is parallel with the edge ō : a′; the edge a : ĕ(P̆∞) is parallel with the edge a : ŏ or M̄ : ō; the edge ŏ′ : ĕ has the direction of a line from α to ζ; the edge a′ : *e*(∞P) is parallel with the edge P : a; and finally the edge *e* : ŏ′ has the direction of a line drawn from *p* to ζ.

In this manner the intersections of all possible planes may be determined and transferred. It should be observed that similar parts of a crystal are similarly modified. Figure 12 is a completed representation of a crystal which presents the planes above designated, viz.

0P . ∞P̄∞ . ∞P̆∞ . P . 2P . 2P̄2 . 4P̆2 . P̆∞ . $\frac{4}{3}$P̄∞ . 2P̄∞ . ∞P
P M̄ M̆ a a′ ō ŏ′ ĕ ē′ ē″ *e*

This same descriptive expression applies equally to fig. 13, which contains the same planes as fig. 12, but differently proportioned in size. The planes M have been diminished by the enlargement of *e*, thus producing a modified rhombic prism. The directions of the intersections are identical with those in fig. 12. This figure illustrates a preceding remark (§ 19), that the descriptive expressions of planes indicate merely their situation and not their size.

According to the same method, crystals may be projected in each of the crystallographic classes, after their axes have been accurately laid down. It was remarked that the figure employed for determining the intersections should be large: in a large figure slight variations from the true direction or position of lines produces errors of less magnitude. Also the lines should be carefully and delicately drawn. With the point of a needle on glazed cards, a very great degree of accuracy may be attained.

PROJECTION OF SIMPLE SECONDARY FORMS.

21. *Monometric system.*—The projection of many of the simple secondary forms,—for example the trisoctahedrons, the hexoctahedrons, &c.—by the method of construction which has been explained, would be a long and tedious process; at least when compared with the more simple method, depending on the relative lengths of the axes and the rhombic and trigonal interaxes in these forms. The right lines passing through the centre of the octahedron to the centres of its edges, are called *rhombic interaxes;* and those which pass to the centres of the faces, are the *trigonal interaxes.* In the several monometric forms, the extremities of one or more of these interaxes extended or diminished in their lengths, occupy the ver-

tices of the solid angles. If therefore these points (the extremities of the interaxes,) can be determined in the several crystalline forms, it will only remain to connect them, in order to form a projection of these solids. The principles of analytical geometry afford the means of determining how much the interaxes of the octahedron must be increased or diminished to equal the interaxes in these different forms. It is thus found that each half of a trigonal interaxis must be increased by that portion expressed in the fraction

$$\frac{2\,mn-(m+n)}{mn+(m+n)};$$

and for each half of a rhombic interaxis, we have the corresponding fraction

$$\frac{n-1}{n+1}.$$

By giving m and n different values from 0 to ∞, the values of these interaxes for any monometric form may be obtained. The following values are thus deduced for several occurring forms;

		Trig. interaxes.	Rhombic interax.
Trigonal trisoctahedron (fig. 20.)*	$2O$	$\frac{1}{5}$	0
Dodecahedron (fig. 7.)	∞O	$\frac{1}{2}$	0
Hexoctahedron (fig. 25.)	$3O\frac{3}{2}$	$\frac{1}{2}$	$\frac{1}{5}$
"	$4O2$	$\frac{5}{7}$	$\frac{1}{3}$
"	$5O\frac{5}{3}$	$\frac{2}{3}$	$\frac{1}{4}$
Tetrahexahedron (fig. 11.)	$\infty O2$	1	$\frac{1}{3}$
"	$\infty O3$	$\frac{5}{4}$	$\frac{1}{2}$
Tetragonal trisoctahedron (fig. 16.)	$2O2$	$\frac{1}{2}$	$\frac{1}{3}$
"	$3O3$	$\frac{4}{5}$	$\frac{1}{2}$
Cube,	$\infty O\infty$	2	1

To construct the form 4O2, the octahedron is first to be projected, and its axes and interaxes drawn. Then add to each half of each trigonal interaxis, five sevenths of its length; and to each half of each rhombic interaxis, one third of its length. The extremities of the lines thus constructed, are situated in the vertices of the solid angles of the hexoctahedron 4O2, and by connecting them, the projection of this form is completed.

22. In the *inclined hemihedral* monometric forms—that is, those hemihedral forms whose opposite faces are inclined to one another and not parallel, as the tetrahedron, &c.—the rhombic interaxes do

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* For these and the following references to figures, the reader is referred to the copperplates in my system of Mineralogy.

not terminate in the vertices of the solid angles, and may therefore be thrown out of view in the projection of these solids. The two halves of each trigonal interaxis, terminate in the vertices of dissimilar angles, and are of unequal lengths. One is identical with the corresponding in the holohedral forms, and is called the holohedral portion of the interaxis; the other is the hemihedral portion. The length of the latter may be determined by adding to the half of the octahedral interaxis, that portion of the same indicated in the formula,

$$\frac{2\,mn-(m-n)}{mn+(m-n)}$$

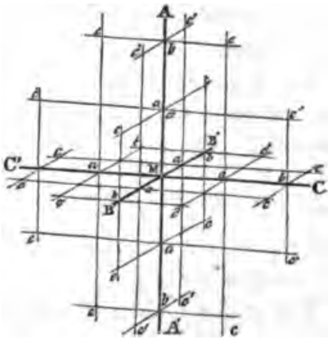
If the different halves of the trigonal interaxes, be assumed at one time as the holohedral and again as the hemihedral portion, the reverse forms $\frac{mOn}{2}$ and $-\frac{mOn}{2}$ may be projected. The following table contains the values of the above fraction for several of the inclined hemihedral forms and also the corresponding values for the holohedral portion of the interaxis.

		Holohed. interax.	Hemihed. interax.
Tetrahedron (fig. 30.)	$\frac{O}{2}$	0	2
Trigonal hemitrisoctahedron (fig. 34.)	$\frac{2O2}{2}$	$\frac{1}{2}$	2
"	$\frac{3O3}{2}$	$\frac{4}{5}$	2
Tetragonal hemitrisoctahedron (fig. 40.)	$\frac{\frac{3}{2}O}{2}$	$\frac{1}{8}$	$\frac{5}{4}$
"	$\frac{2O}{2}$	$\frac{1}{5}$	1
Inclined hemihexoctahedron (fig. 41)	$\frac{3O\frac{3}{2}}{2}$	$\frac{1}{2}$	$\frac{5}{4}$
"	$\frac{4O2}{2}$	$\frac{5}{7}$	$\frac{7}{5}$
"	$\frac{5O\frac{5}{3}}{2}$	$\frac{2}{3}$	$\frac{8}{7}$

23. The *parallel hemihedrons*, (for example, the Pentagonal Dodecahedron, or Hemi-tetrahexahedron) contain a solid angle, situated in a line between the extremities of each pair of semiaxes, which is called an unsymmetrical solid angle. The vertices of these angles are at unequal distances from the two adjacent axes,

and therefore are not in the line of the rhombic interaxes. The coordinates of this solid angle for any form, as $\frac{[mOn]}{2}$, may be found by the formulas $\frac{m(n-1)}{mn-1}$ and $\frac{n(m-1)}{mn-1}$. By means of these formulas, the situation of two points, *a* and *b*, (fig. 14.) in each of the axes may be determined: and if lines are drawn through *a* and *b* in each semiaxis parallel to the other axes, the intersections *c*, *c′* of these lines will be the vertices of the unsymmetrical solid angles, those marked *c* of the form $\frac{[mOn]}{2}$ and those marked *c′*, of the form $-\frac{[mOn]}{2}$.

Fig. 14.



The trigonal interaxes are of the same length as in the holohedral forms. The values of these interaxes, and of the coordinates of the unsymmetrical solid angle for different parallel hemihedrons, are contained in the following table.

		Trigonal interaxis.	Coord. of the unsym. solid angle.	
Parallel hemihexoctahedron (fig. 49.)	$\frac{[3O\frac{3}{2}]}{2}$	$\frac{1}{2}$	$\frac{3}{7}$	$\frac{6}{7}$
"	$\frac{[4O2]}{2}$	$\frac{6}{7}$	$\frac{4}{7}$	$\frac{6}{7}$
"	$\frac{[5O\frac{5}{3}]}{2}$	$\frac{2}{3}$	$\frac{5}{11}$	$\frac{10}{11}$
Hemitetrahexahedron (fig. 44.)	$\frac{[\infty O\frac{3}{2}]}{2}$	$\frac{4}{5}$	$\frac{1}{3}$	1
"	$\frac{[\infty O2]}{2}$	1	$\frac{1}{2}$	1
"	$\frac{[\infty O3]}{2}$	$\frac{5}{6}$	$\frac{2}{3}$	1

24. *Dimetric system.*—In an octagonal pyramid, mPn (fig. 59.) the interaxes, or diagonals symmetrically intermediate between the horizontal axes, terminate in the interaxal basal angles. Their length exceeds the length of the interaxes of the octahedron, by a portion equal

to $\frac{n-1}{n+1}$. If therefore the octahedron mP and its interaxes be projected, and these interaxes be increased by a portion of their length expressed in the fraction, $\frac{n-1}{n+1}$, they will equal the interaxes of the octagonal pyramid mPn. This solid may then be projected by connecting the extremities of these interaxes, with the extremities of the horizontal axes, and joining all the angles of the octagonal base thus formed, with the extremities of the vertical axis.

25. *Tetraxonal system.*—The dihexagonal pyramid (fig. 126.) may be projected in the same manner as the octagonal pyramid just described; that is, by increasing the interaxes by a portion equal to $\frac{n-1}{n+1}$, uniting the points thus determined with the horizontal axes, and connecting the angular points of the base thus projected, with the extremities of the vertical axis.

The scalenohedron (fig. 116.) $m\mathrm{R}^n$ admits of a similar construction with the rhombohedron mR. The only variation required, is to multiply the vertical axis, by the number of units in n, after the points E and E′ in the rhombohedron mR have been determined; then connect the points E, or the points E′, with one another and with the extremities of the vertical axis.

Art. IV.—*Meteorological Sketches;* by an Observer.

[Prepared for the 13th edition of the American Coast Pilot.]

The science of Meteorology is not only interesting to the philosophic observer, but the natural phenomena of which it takes cognizance, are such as daily affect the interest and comfort of every member of the human family. But to no class of persons are these phenomena, as exhibited in various parts of the world, of so much practical importance as to the members of the nautical profession. A competent knowledge of these exhibitions, or of geographical meteorology, is therefore an important element of that varied knowledge which is acquired by the skillful navigator.

General View of the Atmosphere.

The transparent aerial fluid which surrounds our globe, and which we denominate *the atmosphere*, forms a comparatively thin stratum or envelope, which in the immediate vicinity of the earth, is greatly compressed by its own weight, and which in its most expanded and tenuous state is supposed to extend itself to the height of only forty-five or fifty miles from the earth's surface. Its superincumbent pressure or weight is ascertained by means of the barometer, and is equal to a column of mercury about thirty inches in height. By means of this instrument we learn that one half its weight or actual quantity is within three miles and a half of the surface of the ocean; and it is within this limit that nearly all the visible or important phenomena of the atmosphere are apparently developed. The superficial area of the lower surface of the atmosphere is equal to about 200,000,000 square miles; and as a compression of the whole mass to the common density which it exhibits at the sea level, would reduce its entire height to about five miles, it follows that by this standard of comparison the height or thickness of the atmosphere is to its superficial extent in the proportion of only 1 to 40,000,000.

These several facts are too important to be lost sight of, in our general reasonings upon the phenomena of the atmosphere; and the more so, as we are prone to give too much *altitude* to our conceptions on these subjects. If we even consider the proper height or thickness of the atmosphere as equal to fifty miles, still, as compared with its entire surface, this is only equal to one five hundredth of the proportion which the thickness of a common sheet of paper, of the foolscap size, bears to its surface dimensions; and if we view the atmosphere either as condensed to the mean of the surface pressure, or in relation to the actual limit of all its tangible phenomena, it will only be equal to one five thousandth part of the proportional thickness here mentioned. We may hence perceive the inapplicability of analogical reasonings that are founded on the movements which occur in a chimney, or in an inclosed apartment, as attempted to be applied in explanation of the general movements of the atmosphere.

Two instruments of modern invention, the *barometer* and *thermometer*, are truly invaluable as testing the condition of the atmosphere, and their use should be familiar to every navigator. By the first, as we have seen, the amount or weight of the superincumbent atmosphere, at any place, may always be accurately known, and by the indications of the other the temperature of the air as well as of the ocean, may be ascertained with equal precision.

Among the most striking peculiarities of the atmosphere, are its rapid and almost constant movements of progression or circulation, which, with some unimportant exceptions, appear to prevail throughout the globe. These movements evidently show the continued operation of some powerful impulse, which, to the writer at least, does not appear to have been satisfactorily explained. It is estimated from the average rate of sailing of ships during long voyages through different seas, and from other data, that the average velocity of the wind near the surface of the ocean is equal to eighteen miles an hour throughout the year, and in the common region of the clouds the velocity must be much greater.

Temperature of Elevation.

Elevation above the level of the sea, or the general level of a country, causes a regular variation in temperature. The first 300 feet usually cause a difference of about 1 degree of Fahrenheit's thermometer. After ascending 300 feet, it is estimated that the thermometer falls a degree in 295 feet, then at 277, 252, 223, and 192 feet; but 300 feet to a degree is a common rule. On these principles the limit of perpetual frost has been calculated. It is made a little more than 15,000 feet at the equator, and from that to 13,000 between the tropics, and from 9,000 to 4,000 feet between latitudes 40° and 59°.

It has been found, however, that the above rule is subject to great variations, owing, probably, to the course, temperature, and superposition of the atmospheric currents which prevail in different regions, and at different altitudes. Colder currents are often found resting upon, or interposed between, those of a higher temperature, and *vice versa.* On the Himalaya Mountains, in Asia, between the latitudes of 28° and 34° north, the region of vegetation has been found to extend several thousand feet above the supposed line of congelation in those latitudes. It is also remarkable that the line of perpetual snow is found at a much greater altitude on the *northern* side of these mountains than on the southern side in a lower latitude. From this it may be inferred that the temperature in high regions, as well as in lower situations, is greatly affected by the geographical course and physical condition of the currents of atmosphere which prevail in those regions.

Stratification and Elevation of the Currents of the Atmosphere.

It is obvious, from the courses of the clouds and other light bodies which sometimes float in the atmosphere, that the movements of the latter are mainly horizontal, or parallel to the earth's surface. Notwithstanding this, the common theory of winds supposes a constant rising of the atmosphere in the equatorial regions, connected with a flow in the higher atmosphere towards the polar regions, and a counter flow at the surface towards the equator, to supply the ascending current. This ascending movement, however, has never yet been discovered, and it is easy to perceive that if it existed in the manner supposed, its magnitude and velocity must be altogether too great to have eluded observation.

It is apparent, however, that different currents often prevail at different altitudes, superimposed one upon another, and moving at the same time in different directions. These currents are often of different temperatures and hygrometrical condition, and are found moving with different degrees of velocity. It is by the influence of these currents that volcanic ashes, and other light substances, which are elevated by means of volcanic spouts or whirlwinds to the higher regions of the atmosphere, are conveyed to great distances, and in directions which are often contrary to the prevailing wind at the surface. On the eruption in St. Vincent, in 1812, ashes were thus deposited at Barbadoes, which is 60 or 70 miles to the windward, and also on the decks of vessels still farther eastward, while the trade wind was blowing in its usual direction. On the great eruption of the volcano of Cosiguina, on the shores of the Pacific, in Guatemala, in January, 1835, the volcanic ashes fell upon the island of Jamaica, at the distance of 800 miles in a direct line from the volcano. Facts like these ought to put at rest the common theory of the trade winds, according to which these ashes would sooner have fallen upon the northern shores of the Gulf of Mexico, or the peninsula of Florida. On the same occasion the volcanic ashes were also carried westward in the direction contrary to the trade wind on that coast, and fell upon H. M. ship Conway, in the Pacific, in lat. 7° N., long. 105° W., more than 1,200 miles distant from the volcano, in the direction which is nearly opposite from that of Jamaica. These phenomena were doubtless the effect of two different currents prevailing at different elevations; but we shall seek in vain, in these developments, for proof of the commonly received but imaginary system of the trade winds.

The occasional interposition of a warmer current of atmosphere between the lower current and the higher regions, has been proved by the observations of aeronauts. In countries situated like the United States, where the surface is often occupied in winter, for long periods, by an intensely cold stratum of air from the interior elevations, the warm currents from lower latitudes appear to find their way at a superior elevation; and their presence in this position is often demonstrated by the phenomena which they induce.

Clouds, Fogs and Rain.

The atmosphere is always pervaded by water in the form of transparent or invisible vapor, and the process of evaporation is continually carried on, except in cases where the thermometer is below what is called the dew point, or when the vapor is being condensed in the form of clouds, fogs, or rain. "Clouds and fogs are the same thing, being an assemblage of small vesicles of water floating in the atmosphere. At a distance in the atmosphere we see the whole as a cloud, but when the vapor sinks to the earth, or will not rise, and we are immersed in it, we call it a fog. Dew-fogs which hang over fields, are *stratus* clouds; and fogs which involve elevated objects, are *cumulous* clouds." It is to circumstances of distribution, light, shade, distance, and perspective, that the great variety in the *appearance* of the clouds is owing; and on this variety of appearance the following classification has been founded, by which the clouds have been considered as pertaining to seven classes:

1. Like a lock of hair, or a feather, called *cirrus.*
2. A cloud in conical or rounded heaps, called *cumulus.*
3. A horizontal sheet, called *stratus.*
4. A system of small fleecy or rounded clouds, called *cirro-cumulus.*
5. The wavy or undulating stratus, called *cirro-stratus.*
6. The cumulus and cirro-stratus mixed, called *cumulo-stratus.*
7. A cumulus spreading out in cirrus, and raining beneath, called *nimbus.*

The cirrus is usually the most elevated—sometimes as a gauze veil, or parallel threads. Its height is apparently from one to four miles.

Dew is the condensation of aqueous vapor upon the surface of a condensing body or substance. Clouds and fogs are watery particles condensed from aqueous vapor while floating in the atmosphere, where they continue to float till precipitated, or again dissolved. If by the concentration of these particles, or by any additional condensation, their weight be increased beyond that which the extent of their surface can sustain, they then descend in the form of rain; and as the condensation ordinarily increases as the drops increase in magnitude, it is common to have more rain fall on the surface of the ground than on an equal space upon the top of a house or church. Clouds, fogs, and rain are therefore essentially the same, the latter being the continuation or extension of the same process which produced the former.

Owing to the evaporating properties of the atmosphere in the higher regions, as well as the intensity of cold which there uniformly prevails, distinct clouds are seldom, if ever, found at a greater elevation than the summits of the highest mountains, which is about five miles. At an intermediate region, however, the clouds are often at a temperature above freezing, while the air at the surface is much below the freezing point, and the earth covered with snow. This condition of the clouds seems not unfrequently evident by their appearance to the eye of an observer. Snowy or frozen clouds are usually dim and undefined in their aspect or appearance; and a fall of snow may not unaptly be termed the fall of a frozen cloud.

Of Hail.

Hail of small size, as it falls in wintry storms, appears as frozen rain-drops. From the occurrence of this phenomenon in a freezing state of weather, we find evidence that a stratum of air in the region of clouds is at a temperature above the freezing point, or warmer than that which is found at the surface at the same time. A heavy fall of snow when the temperature is much below the freezing point, affords, perhaps, the same indication.

Summer hail of large size, which is deposited in a definite path or vein, or in a locality of limited extent, is usually accompanied by heavy thunder and vivid or continued lightnings, or a heavy rumbling sound or rapid concussions, high winds, &c., and is believed to be the production of a vortex or whirlwind in the atmosphere, or *spout* as it is sometimes called, which is connected at its upper extremity with an overlying stratum of unusually cold air. A portion of this cold stratum probably descends on the exterior of the vortex, and on approaching the earth's surface, is pressed into the vortex and there entwined or laminated with the layer of warm and humid air of the surface, which is drawn in at the same time. A rapid condensation, as is known, thus commences at the lower extremity of the whirling mass or column, and the condensed and frozen drops, passing into layers of air of a temperature alternately above and below the freezing point, are carried upward by the powerful whirling and ascending action of the vortex, till, with the successive coatings of condensation received, they are finally discharged into the cold stratum at the upward extremity of the vortex, owing to the reduced temperature of which, they are prepared to receive a renewed accession during their fall to the earth; or perhaps by their accumulated weight they are sometimes thrown through the sides of the vortex before reaching its higher extremity. By this violent whirling and elevating action, some of the hail-stones are thrown against each other and broken; and each successive layer of congelation may often be seen in the fractured sections of the hail. In all vorticular condensations of this character, when the cold is not sufficiently intense to produce hail, drops of rain are produced of a much greater size than are ever found in a common and direct fall of rain.

Hail storms of this character are less frequent in the tropical regions than in the temperate latitudes, for the reason, probably, that a stratum of sufficient cold to produce the hail, is seldom found so near the lowest stratum that a vorticular communication can be established with the former, by means of an ordinary gust, spout, or whirlwind. Nor does this ordinarily happen in the temperate latitudes; but only when the lower warm stratum becomes overlaid, in close proximity, by a stratum from a colder region; an event which is not unfrequent in most countries within the temperate latitudes. It commonly happens, therefore, that several hail storms of greater or less magnitude and violence, occur on the same day, or about the same period.

Of Thunder Storms and Gusts.

When a cold stratum or current of the higher atmosphere moves or rests upon a warm one which is next the earth, neither stratum, as such, can penetrate or displace the other. Nor can a sudden interchange or commingling take place between the masses or particles of which these strata are composed, except by the slow and tedious process of the successive action and convolution of single particles, or small groups of particles, upon or around each other; but if a communication or interchange between the two strata becomes established by means of the action of a gradually excited whirlwind or water-spout, or if, owing to any inequality of surface or other accident, a depression is made upon the lower stratum, so as to enable the colder air to descend at this point, then an immediate gyration or convolution will take place in the two masses at this point, the warm air rising as it becomes displaced, and a copious condensation will immediately follow. It is movements of this character which produce the dense and convoluted appearance known as a thunder-cloud, and the thunder and lightning, rain, and perhaps hail, follow as necessary results.

The precipitation of the colder stratum thus commenced, is regularly continued and enlarged till an equilibrium is produced, and the thunder storm thus engendered, assumes, of course, the direction of the upper current to which it is appended, and which, in the temperate latitudes, is commonly from the western quarter. The warm surface air which is thus displaced at the commencement of the process, rises immediately in front of the colder intruding mass, and by the gyratory action thus commenced, becomes convolved in detached masses or layers with the colder surrounding air, and by the reduction of temperature thus produced, furnishes the large supply of aqueous vapor which is first condensed in the thunder cloud, and then precipitated in a heavy fall of rain; and the electric phenomena which are induced by this sudden contact or intermingling of masses of air of different temperatures and hygrometric conditions, become highly vivid, and too often destructive. The active gyration which is commonly produced within the body of the thunder storm or gust, is in the direction of the advance of the storm and of the rising warm air which is forced upward, or in the direction of forward and upward at the lower front of the storm.*

In consequence of this gyratory action, a storm which advances at the rate of fifteen or twenty miles an hour, is often known to exhibit a velocity of wind during the period of its greatest violence, of sixty or eighty miles an hour. If the axis of this gyration in a thunder storm assumes, from any cause, a vertical position, we then have a perfect whirlwind or tornado, which, if it be so situated as not to reach the earth by its direct action, will exhibit to us the phenomena of a heavy thunder storm accompanied by rumbling sounds and concussions, and a fall of hail in or near some portion of its path. But if the regular action of the whirlwind should reach the earth, and continue for some time, great destruction may be expected to follow. The path of these destructive whirlwinds is generally narrow, and often but a few hundred yards in width.

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* See also Prof. Mitchell on thunder storms: Am. Jour. of Science, Vol. XIX. p. 278—282.

From the nature of the causes which we have before mentioned as being favorable to the occurrence of a thunder storm, it follows that many of these storms will be likely to occur on the same day, in different parts of the same country, as has been already remarked in the case of hail storms, with which they are often identical; and the writer has often found this to be true to a remarkable extent. The fatal accidents by lightning, in different parts of the country have often happened on the same days, and we have reason to believe that scores of tornadoes, hail storms, and thunder storms, have sometimes occurred on the same afternoon. It usually happens that the precipitations of colder atmosphere at these numerous points of disturbance, are sufficient to produce a marked change in the temperature of the surface stratum within a period of twelve hours thereafter.

Atmospheric disturbances of this kind, which do not produce violent thunder or hail, are usually denominated *squalls;* and it appears highly probable that the presence of air of a temperature considerably above the freezing point, is necessary to the production of thunder and lightning. In the Strait of Magalhaens, in Patagonia, where the air at the surface is neither warm nor very cold, the squalls, called by the sailors williwaws, are very frequent, and tremendously severe; but, according to the observations of Capt. P. P. King, lightning and thunder are seldom known.

The heavy condensation presented in a thunder cloud, is often spoken of in a manner which implies that the cloud possesses some mechanical or other energy, by means of which the violent wind is sent forth; but nothing can be more unreal than such a supposition. The cloud may indeed be the means of electric development, and furnishes also the watery deposition for the hail or rain, but all the particles of the cloud are passively inert, like those of a common fog or mist, and the violent winds and disturbing forces which may be present, operate to produce the cloud, but do not, in any important sense, result from its action.

Water-spouts and Whirlwinds.

The character of these meteors has already been described, in a measure, in our account of hail and thunder storms. The identity of whirlwinds and water-spouts, was maintained by Franklin, and although at a later period this has been called in question, it appears to have been done without sufficient reason.

From the equal distribution of the atmosphere as the oceanic envelop of our earth, it results, that no movement of great violence can take place in any of its parts, except by means of a direct circuit of rotation in the form of a vortex or active whirlwind.

A vortex will not be regularly formed, nor continue itself in action, without the aid of an external propelling force and a constant spiral discharge from that extremity of its axis towards which is the tendency of motion. Both these conditions, it is believed, are fulfilled to the letter in the case of a common whirlwind or water-spout. The air at the upper extremity of the whirling column, owing to its elevation, is rarer than at the base, and the column itself, particularly in its central portions, is mechanically rarefied by the centrifugal effect of its own whirling motion. We have thus a sort of rarefied chimney into which the denser air at the base of the column is continually forced, by the pressure of the surrounding atmosphere; not to ascend in a separate current as in the common chimney, but entering into the organization of the whirling vortex, to supply the place of the preceding portions of air which are winding inwards and upwards to be again discharged at the upper extremity. The condition of force by which the propulsion is maintained, is found in the pressure of the surrounding atmosphere upon all sides of the whirling and therefore mechanically rarefied column, and if the expansive whirling motion be sufficiently active to produce nearly a vacuum at the center, the external propelling force will be nearly fifteen pounds to the square inch. As the whirling column turns within its own compass like a top or any other rotative body, this force is quite sufficient to account for all the violence that is ever produced.

Were there no vorticular or whirling action already excited, and no discharge from the upper extremity of the vortex, there could then be no inequality of pressure to produce rotation; but this movement and upward discharge having once commenced, from any cause, the particles near the exterior of the column, like those of water in a funnel, yield at a little more than a right angle, to the external pressure, in their spirally approximating course towards the rarefied center. By the slowness of this central approximation as compared with the whirling action, the intensity or magnitude of the external pressure becomes gradually merged in the velocity of the rotative action. As the area of the spiral circuit decreases rapidly as we approach the center, it follows that the velocity of the whirling movement must be proportionally increased, as we perceive it to be in the funnel and in all regular formed vortices. Thus, if the rotative velocity near the exterior of the whirling column be at the rate of but ten miles an hour, at one third nearer the center the velocity must be more than doubled, and at two thirds of the distance from the first named point to the center, the absolute whirling velocity must be increased nine fold, which in this case is equal to ninety miles an hour; and in consequence of the reduced diameter of the circuit of gyration at the last point, the number of revolutions must here be as four hundred, to one at the point first mentioned. The increased ascending velocity, however, is not here taken into account, which may perhaps reduce the number of comparative revolutions in the central portions of the column. The extraordinary condensing and electric effects which often attend or follow these active whirlwinds, have been cursorily noticed under the head of thunder storms and hail.

It is not intended to dwell here upon the causes by which whirlwinds and spouts are excited or first set in motion, but local disturbances in a heated stratum, at points where the same is beginning to be penetrated by the colder air of a higher stratum, are probably the chief exciting cause as in thunder storms. The agency of heat may also be effective in continuing the upward discharge and vorticular organization, in cases where there is great disparity in the temperature of the air at the upper and lower extremities of the whirling mass or column, but it is to the mechanical expansion caused by the centrifugal action and the powerful impulse of the external atmospheric pressure, that the increased and powerful activity of the whirlwind is chiefly to be referred.

The term *water-spout* is undoubtedly a misnomer, as there is no effect produced of which this term is properly descriptive, although the term air-spout would not be greatly inappropriate. The visible column of condensed vapor which often appears in the rarefied center of the vortex when the latter is not enveloped in cloud, has probably given name to this meteor. But the water of the sea is not taken up by the spout or whirlwind, except in a slight degree and in the form of fine spray, like other light matter which is swept from the surface. This cloudy stem or column frequently appears and disappears, while the action of the whirlwind continues without any important change. Owing to this fact, observers sometimes believe that they witness the commencement of a water-spout, or tornado, when the same has previously been in action for one or more hours, and when the cloudy pipe or pillar happens to disappear, the spout is supposed to have 'burst,' while, often, it has undergone no important change, except, perhaps, a slight decrease in its activity. The active and violent portion of the whirlwind surrounds the spout invisibly, and is probably of much greater diameter at a distance from the surface of the earth than at the base of the spout. Thus, when a spout or whirlwind has passed near a ship, the upper spars have been converted into wreck while no violence of wind was felt on the deck.

Water-spouts follow the course either of the surface wind or of the higher current with which they may communicate, or their course may be modified by both these influences without being absolutely determined by either. They abound most, however, in those calm regions which are found at the external limits of the trade winds, and in the regions near the equator.

It has been common to ascribe whirlwinds and water-spouts, as well as larger whirlwind storms, to an impulse produced by the meeting of contrary currents, but the laws of distribution and of motion in an oceanic body, are such as do not permit the movements of its different currents and gyrations to meet in conflict with each other; besides, any conflicting movement in the air would necessarily produce a rise in the barometer, whereas it is generally known to fall at the commencement of a storm or whirlwind, either of large or small extent. We may observe, also, that whirlwinds and spouts appear to commence gradually, and to acquire their full activity without the aid of foreign causes; and it is well known that they are most frequent in those calm regions where, apparently, there are no active currents to meet each other, and they are least frequent where currents are in full activity.

Of Trade Winds and the circuitous Character of the Atmospheric Currents.

It is found that in almost every country, and in every sea, the wind is more or less predominant in a particular direction. In open sea, between the equator and the 30th parallel of north and south latitudes, the wind, for the most part, blows from the eastward; but near the eastern borders of any ocean, below these latitudes, the wind blows in a direction more towards the equator than in its central or western portions.

In the higher latitudes north of 30°, the westerly winds are found greatly to predominate, although the eddying or rotative action which is acquired by large portions of the lower stratum of air in these latitudes, causes much diversity and frequent changes in the specific direction of the local winds. But in the common region of clouds, where this eddying movement is less frequent, the main atmospheric current, at least in the United States, is fully as constant from the westward, as is the trade wind from the eastward in any tropical region.

At New York, in four successive years the westerly winds have been found to be to the easterly, as nearly as two to one. Observations on the courses of the clouds for the same period, show the prevalence of an atmospheric current from the westward at that elevation to be, as compared with those from the eastward, nearly as fourteen to one; the prevailing wind being southwesterly. At Montreal, in Lower Canada, as appears by the observations of J. M'Cord, Esq. the westerly surface winds also appear to exceed the easterly, in the proportion of more than four to one. In consequence of the general prevalence of westerly winds and currents in these latitudes, the passages of the fastest ships, from Europe to America, are found to occupy a much longer period than from America to Europe.

The first movement of the trade winds towards the equator and westward, necessarily occasions an equal movement from the higher latitude to supply their place; and as the trade winds in their progress westward are opposed by the American and Asiatic continents, across which these winds do not pass, it follows that these winds become deflected or thrown off towards the poles in order to support an equal distribution of the atmosphere in the higher latitudes; but the air thus transferred to these latitudes carries with it the rotative impulse which it acquired in the tropical latitudes, and by reason of the slower rotative motion which here prevails, is thrown to the eastward in the form of westerly winds.

An entire circuit of atmospheric currents is thus maintained on both sides of the equator, the most equable and determinate portion of which is to be found in the region of the trade winds; and this appears to be the general outline of the great system of circulation in our atmosphere, as well as in the ocean itself. It is to the geographical course pursued by the winds in different portions of these great circuits that the peculiarities of temperature and climate pertaining to different countries lying in the same latitudes, are chiefly to be referred, as also the remarkable absence or predominance of *rain* which is peculiar to certain regions.

The Monsoons of the Indian Seas are but a modification of the same system of circulation; the regular trade wind instead of turning towards the higher latitudes, being here deflected across the equator, where it returns to the eastward in the form of the *westerly* monsoons; the *easterly* monsoons being the regular trade wind. The monsoons have, indeed, been ascribed to local rarefaction in Asia and New Holland, but the northwesterly monsoon, regardless of this hypothesis, sometimes sweeps over half the breadth of the great Pacific Ocean in its eastwardly progress.

The above generalization may also be expressed in the following form:

I. Between the two parallels of 30° N. and S. the atmosphere at the earth's surface, for the most part revolves around the axis of the earth with a slower motion than the earth's crust, or is constantly being left behind in the movement of rotation.

II. The space previously occupied by the atmosphere so left behind, is by the centrifugal action of the earth's rotation, constantly supplied from the higher latitudes.

III. That portion of the atmosphere which is left behind in the tropical latitudes, and passes westward by the earth's rotation, as above described, is, by the force of direct gravitation, constantly transferred to the higher latitudes; thus preserving the equilibrium of distribution, so far as the same is ever maintained in these latitudes.

IV. That portion of the atmosphere which is so transferred to the higher latitudes after having acquired the high rotative velocity of the equatorial regions, is by this previously acquired impulse, thrown rapidly eastward in the form of westerly winds, thus completing the great circuit of perpetual gravitation, which is developed in each of the oceanic basins on both sides of the equator.

It is by the currents of these natural circuits of gravitation, that hurricanes and storms are found to be transported from one region or locality to another; and the track of these storms affords demonstrative evidence of the predominating course which these currents pursue. Different sections of these currents often become locally modified in their apparent courses from various causes, and being often stratified, or as it were *shingled* upon each other, they exhibit in their crossings, specific movements in different directions, and consequently frequent changes at the surface, while still performing with no little regularity the systematic courses which have been summarily pointed out. One obvious cause of the local irregularity and superposition of these currents is found in the retardation to which the lowest portions of the air are subject, owing to the resistance of the earth's surface.*

The rotative motion of the atmosphere and the earth's surface in the latitudes which form the boundary between the trade winds and the returning westerly winds being nearly equal, this region is necessarily subject to calms, and to those sudden gusts and squalls which are usually excited in warm regions in the absence of a prevailing wind. This region, in the North Atlantic, is known to navigators as the *horse latitudes*, because the traders between New England and the West Indies, in consequence of the lack of sustenance occasioned by these calms, were sometimes under the necessity of throwing overboard the whole or a part of their deck loads of horses. The great circuits of winds intersect and cross these latitudes in both directions on almost every meridian, but with little sensible effect at the surface, except towards the eastern margin of the Atlantic, where the northerly winds decidedly prevail; and towards the western margin of the Atlantic and in the Gulf of Mexico, where the southerly winds are usually prevalent.

Similar results are found in nearly all the regions which separate the great natural circuits of winds from each other, and these tracts of ocean are known by the designation of *the calms*, and sometimes are called the *rains* or the *variables*. Such is the region about the equator, which separates the northern from the southern trade winds, and the easterly from the westerly monsoons. The easterly monsoons, in approaching the equator, where they run into the westerly monsoons, necessarily acquire the same velocity of rotation as the earth's crust, which of course produces calms; the northerly or southerly tendency of the monsoons being here too small to produce a leading breeze at the surface.

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* There is one point of some interest which it has not been found convenient to introduce into these sketches, viz. an explanation of the causes which tend to produce extensive and successive gyrations in the lower strata or currents of air which pass from the tropical to the higher latitudes; and which tend also to obliterate these gyrations in the strata which are leaving the higher latitudes and approaching the tropical regions.

Land and Sea Breezes.

Near the shores of an island or country it is often found that the wind, during different hours of the day and night, blows alternately to and from the land. Or in the case of a general or trade wind which is parallel to the coast, its course becomes alternately modified by an approximation to the above result. This effect has been justly ascribed to the influence of diurnal heat and cold. Not that any vacuum is created by the heat into which the surrounding air rushes, as has sometimes been supposed, nor that a warmed stratum of air necessarily rises from the surface and ascends to the higher regions; for, aside from the general error of these notions, a flat, low, and strongly heated island or coast, is found to have less effect in producing these breezes than a high and sloping country of more even temperature.

The truth appears to be, that when the stratum which lies upon the inclined surface of a coast becomes warmed and rarefied by the daily heat, it is forced by the increment of pressure at its lowest margin to move along the inclined surface of the country in the direction of the greatest elevation, or as near that direction as the prevailing tendency of the lower current will allow. Owing to the cooling process which goes on during the night, the specific gravity of this inclined stratum becomes predominant, and the reverse movement then commences and continues into the following morning. We find, too, that on the slopes of certain coasts and islands where there is sufficient elevation, the higher margin of this stratum, at certain seasons, will daily reach an altitude at which it is brought in contact with a higher stratum sufficiently cold to set in operation a squall or thunder storm, at a certain hour; after which the equilibrium is restored, and the usual counter movement again follows in its turn.

Some diurnal effect of this kind upon the wind may be observed at times in almost every region; and, taken altogether, it is probably the most extensive agency which is exercised by heat in the production of winds. R.

Art. V.—*Description of an Alembic for distilling Amalgam of Gold*, contrived by M. F. Maury, U. S. N.

The common process of treating amalgam, at the gold mines in Virginia, consists in getting rid of the excess of quicksilver, either by straining, or simply by pouring it off, after it has been allowed to stand long enough in a crucible or other vessel, for the gold to settle at the bottom. The latter is the method more generally practiced, though at the *surface* or *deposit* mines, where the gold is found in larger particles, the amalgam is freed from the excess of quicksilver, by holding it between the palm of the left hand and the thumb of the right, and forcing the excess of quicksilver off by pressure. The residuum, a friable mass of quicksilver and grains of gold, contains from twenty to fifty, or even a larger per centum (in weight) of the latter metal; the per centum being largest when the grains of gold are coarse, and least when they are fine. Thus reduced, the amalgam is put into a sheet iron *still*, holding about a pint, or laid in a common shovel, when it is put on the fire, and the quicksilver is "blown off." When the still is used, about twenty five per centum of quicksilver, and some of the gold, are lost; but when the shovel is used, some of the gold, and all of the quicksilver, is lost.

The loss of gold is greatest, when it consists of grains or points impalpably small; for it appears, that that degree of heat, attainable in the operation of "blowing off" the quicksilver, is not sufficient entirely to neutralize the affinity between the two metals. When the gold is *fine*, and the heat quick, much of the former passes off with the mercurial vapor: this is proved by condensing the vapor, and allowing the quicksilver thus obtained to stand for three or four days, when by carefully pouring off the top of it, an amalgam, having the consistency of oil in incipient congelation, is found at the bottom of the vessel. By subjecting this again to the operation of the still, pure gold is obtained. The residuum in this case is about ten per centum of the gross weight of the amalgam.

The metallurgical process of obtaining gold in Virginia is by no means perfect; in every stage through which it passes, from the stamps to the "blowing off" of the quicksilver, there is a wasteful loss of both metals.

All the gold mines yield more in the small than they do in the large way. This difference is the greatest, when the ores are *lean;*

these sometimes give twenty five or fifty and in some instances even seventy five per cent. more of gold by assays made in the closet, than they will yield in the practical way of extracting the metal on a large scale.

Either Chilian mills or *stamps*, commonly the latter, are used for reducing the gangue (slate or quartz) to the state of fine sand; by this operation the larger particles of gold are detached from its matrix, and remain mixed with the sand. The *stamps* are large cast iron pounders, weighing four or five cwt. They tend, by repeated blows, and by keeping up a constant trituration among the grains of pounded quartz, to render the particles of gold, how minute soever these in the first instance may be, still more impalpable.

The gold and sand thus pounded and mixed together, are washed out through a copper sieve, by a constant stream of water from under the stamps, and by it carried thence over several feet of bullocks' hides, resting on an inclined plane, having their hair upwards and the *grain* of the hair turned down stream. The heavier particles of gold, and other weighty minerals, such as the sulphate of baryta, the sulphurets of lead, zinc, iron, copper, and the like, lodge in the hair of the roughly tanned skins, while the sand, and much of the gold in attenuated particles, are carried off together into the waste by the force of the water. At some of the mines the gold is disseminated through the quartz, in particles so minute, that they are seldom visible to the naked eye. When this is the case, much of the precious metal is floated off by reason of its buoyancy. The phenomenon of solid particles of gold being floated on water may be readily understood; for if we imagine a solid cube to be cut from a flake of gold leaf, and this cube to be further diminished by truncation and bevelment, it is very evident, that the specific gravity of this crystal, will not be less than that of the ingot from which the gold beater obtained it; but if it be placed in a vessel of water, in order to sink, it must, in consequence of it and the water not actually touching each other, displace a quantity of that fluid many times greater in volume than the crystal; therefore the latter, whatever its size might be, would not sink, so long as the volume of water to be displaced by sinking, should exceed the crystal in weight. Upon the same principle, a cambric needle will float on water, while the bar of steel from which it was manufactured, will displace several times its own volume of the same fluid, and carry with it to the bottom large pieces of cork and the like.

The gold with the crust and other minerals that do lodge on the skins, is washed off in a tub, whence it is put into a trough, that conducts a stream of water to one or more amalgamators (Tyrolese or Hungarian bowls,) from which is constantly presented another phenomenon in hydrostatics, viz: that of quicksilver rising from the bottom and floating on the surface of water.

Owing to the rotary motion of the amalgamators, the friction of the sand and water against the quicksilver, it tends to separate into minute globes, which rise to the surface, and are floated off; this tendency increases as the quicksilver loses its fluidity and becomes less yielding, which it does by being more and more heavily charged with gold; a considerable portion of which is thus carried off, atom by atom, from the amalgamators.

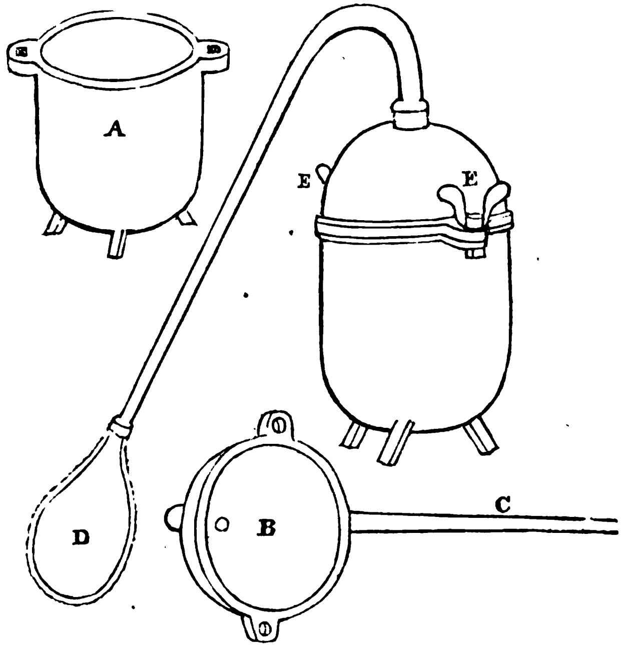
In the course of twenty four hours, two or three per centum of the quicksilver in each amalgamator is lost. About twenty five per centum of that put in the still, and all that put in the shovel, is lost in the operation of "blowing off." There is a loss of gold in the same operation; besides the gold which swims off in the state of amalgam, that which is carried off by adhering to the sand, and that which is floated off into the waste from the skins, and from the amalgamators.

What would be the effect in the amalgamating process, if opposite states of electricity could be induced and kept up between the quicksilver and the gold, until the two metals unite? Would not the tendency to amalgamation be promoted, and in such a case, would not the loss by the floating off the quicksilver and gold be prevented? These questions are proposed, because it is believed that ingenuity is able to supply a practical answer to them. If the metallurgy of gold were better understood, many mines that are now profitless might be advantageously worked.

To save the loss of quicksilver involved in the ordinary process of "blowing off," and to save the gold which escapes with the mercurial vapor, the alembic here described, was invented.

A, is the cucurbit, made of cast iron; it holds half a gallon. B, is the capital, also of cast iron. C, is the beak, made of a gun barrel, bent as in Fig. 2. D, is the condenser, made of India rubber cloth; it was a water bag from the caoutchouc manufactory at Roxbury. The edges of the cucurbit and the capital are ground smooth, so that the escape of vapor may be more easily prevented by luting. The inside of A, is also made smooth, so that the gold may not adhere to the bottom of the alembic. The beak is screwed and rusted into the top of the capital so that the joint may be steam tight. In the other end of the beak is a female screw to receive the screw which is in the mouth of the condenser.

Fig. 1. Fig. 2.



After the inside of the cucurbit has been rubbed with chalk, to prevent the gold from adhering to the iron, in case the former should melt, the amalgam is weighed and put in, and the capital put on and screwed down to the cucurbit, by means of the thumb screws E, E. The condenser *uninflated* is then screwed on to the tips of the beak, the joint luted, and the condenser placed in a bucket of cold water. The joint between the head and the body of the alembic is also coated with a luting of horse dung and pipe clay or fuller's earth.

As soon as the amalgam begins to boil, the condenser becomes inflated with the air, which was in the alembic, and when evaporation ceases, the cold air from the condenser now returns into the alembic, and becoming heated, expands and fills the space formerly occupied by itself and the quicksilver. If while the operation is going on, the heat be suffered not to fall below the boiling point of quicksilver, and the condenser be observed to contract, it is a sure sign that evaporation is no longer going on and that distillation is perfect.

But if the condenser be unscrewed, and the tips of the beak be supposed to remain immersed in water, as soon as the pressure from within (whether by cooling, or from the absence of a fluid to supply vapor,) becomes less than that of the atmosphere without, the water is forced from the bucket through the tube into the alembic, and if the quicksilver be not all evaporated it is wasted, and the alembic is endangered by the concussion and sudden cooling produced within, by the cold water and steam. Therefore as soon at the condenser contracts, the alembic should be removed from the fire, the condenser taken out of the bucket and unscrewed, and the alembic be suffered to cool in the air.

This alembic has been in use at one of the Virginia mines for the last ten or twelve months, and when properly luted, the weight of the gold and quicksilver after distillation has invariably equalled that of the amalgam which they formed previous to the operation. It does away with the necessity of settling and pouring off, or straining, and saves all the gold and quicksilver lost in the common way of "blowing off."

Art. VI.—*Crystallographic Examination of Eremite*; by James D. Dana, A. M., Assistant in the Department of Chemistry, Mineralogy, &c. in Yale College.

[Read before the Yale Nat. Hist. Society, June 19th, 1837.]

At our last meeting we were informed by Mr. Thos. R. Dutton, that he had discovered in a bowlder at Watertown in this State, a few crystals of a mineral, which Prof. C. U. Shepard on examination had announced to be an undescribed species; and that Prof. S. had consequently described it as new under the name of Eremite. Through the kindness of Mr. Dutton, I have examined other crystals in addition to the one investigated by Prof. S. and thus am enabled to add farther confirmation of the conclusion that the specimens belong to a species hitherto unknown.

The crystals are all of them small. The largest is but one fifth of an inch long; the others vary in length from one sixteenth to one twentieth of an inch. The smaller crystals seldom present brilliant faces, and for this reason, as also on account of their minuteness, they scarcely admit of the use of the reflective goniometer. The larger crystal, on the contrary, possesses highly polished surfaces, admitting of easy and accurate measurement. The data for the following calculations have therefore been obtained from the latter alone. Owing to the completeness of the different series of parallel intersections, the crystallographic expressions for the planes of each of the crystals may be deduced with perfect facility and certainty, independently of measurement; and hence, although the planes in some instances are microscopic, their interfacial angles may be accurately determined by calculation. The following are representations of three of these crystals.

Fig. 1, a.

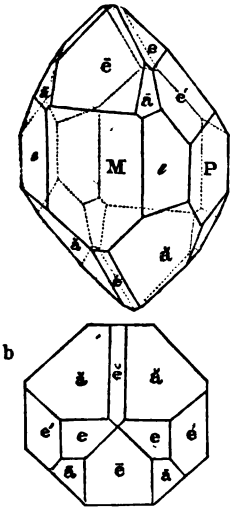


Fig. 2, a.

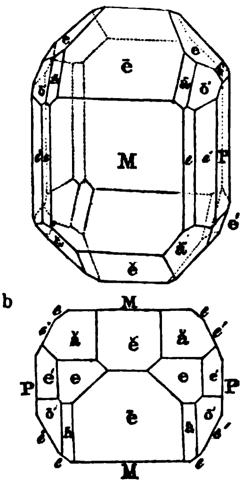
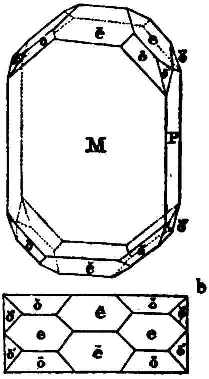


Fig. 3, a.



The character of the crystals is obviously monoclinate. There are no traces of cleavage to indicate whether the primary is the oblique rhombic or right rhomboidal prism; but the size and brilliancy of M and P, two faces of the rhomboidal prism, and the occasional absence of the planes *e*, *e′* which belong to rhombic prisms, favor the conclusion that the latter is the primary. The third plane T, of the rhomboidal prism, has been obliterated by the extension of ē and ĕ.* The crystals have been lettered in accordance with this view; the planes ē and ĕ replacing respectively the obtuse and acute terminal edges; e and e′ each rectangular terminal edge; a and o the obtuse or acute solid angles, according as the mark – or ⌣ is placed over the letter; and *e*, *e′* replacing the lateral edges.

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* The figures represent the crystals as standing on one of their rectangular primary faces (T) as a base. The obtuse edge between M and T, is replaced by the plane ē, and the acute edge by ĕ.

For the determination of the descriptive expressions of the crystal, (in which I employ Naumann's system of notation,) the planes ā may be assumed as faces of the positive fundamental hemipyramid. The following descriptions are thence deduced for the crystals:

Fig. 1. $\underset{M}{\infty P\infty} . \underset{P}{\infty P'\infty} . \underset{e}{\infty P} . \underset{\bar{\mathrm{e}}}{P\infty} . \underset{\bar{\mathrm{a}}}{P} . \underset{\mathrm{e}}{P'\infty} . \underset{\mathrm{e}'}{2P'\infty} . \underset{\breve{\mathrm{a}}}{-P} . \underset{\breve{\mathrm{e}}}{-P\infty} .$

Fig. 2. $\underset{M}{\infty P\infty} . \underset{P}{\infty P'\infty} . \underset{e}{\infty P} . \underset{e'}{\infty P2} . \underset{\bar{\mathrm{e}}}{P\infty} . \underset{\bar{\mathrm{a}}}{P} . \underset{\bar{\mathrm{o}}'}{2P'2} . \underset{\mathrm{e}}{P'\infty} . \underset{\mathrm{e}'}{2P'\infty} .$
$\underset{\breve{\mathrm{a}}}{-P} . \underset{\breve{\mathrm{e}}}{-P\infty} .$

Fig. 3. $\underset{M}{\infty P\infty} . \underset{P}{\infty P'\infty} . \underset{\bar{\mathrm{e}}}{P\infty} . \underset{\bar{\mathrm{o}}}{2P2} . \underset{\bar{\mathrm{o}}'}{2P'2} . \underset{\mathrm{e}'}{P'\infty} . \underset{\breve{\mathrm{o}}'}{-2P'2} . \underset{\breve{\mathrm{o}}}{-2P2} .$
$\underset{\breve{\mathrm{e}}}{-P\infty} .$

The angles assumed as the basis of the calculations are as follow:

M : ē=140° 40′, M : ĕ=126° 8′, M : *e*=136° 35′

The following are the results obtained by calculation. In some instances the angles coincide exactly, in others very nearly, with those which I have obtained with the reflective goniometer.

$a : b : c = \cdot 9471 : 1 : 1\cdot 0265$

$\gamma = 76° 14' \therefore M : T = 103° 46$

ā : ā=119° 22′
ā : T=133° 39′
ā : M=131° 53′
ă : ă=106° 36′
ă : T=121° 6′
ă : M=118° 13′
ā : ă (over e)=109°54′
ō′ : ō′=81° 4′
ō′ : T=121° 18′
ō′ : M=120° 10′
ŏ′ : ŏ′=67° 44′
ŏ′ : T=111° 2′
ŏ′ : M=109° 11′

ō′ : ŏ′(over e′)-130°39′
ō : ō=138° 8′
ō : M=148° 12′
ŏ : ŏ=129° 58′
ŏ : M=141° 25′
ō : ŏ(over e)=70°24′
e : P=131° 52′
e′ : P=150° 50′
$\mathrm{e} : M = \begin{cases} 100° 13' \\ 79° 47' \end{cases}$
$\mathrm{e}' : M = \begin{cases} 93° 6' \\ 86° 54' \end{cases}$
e : ā=148° 20′
e : ă=141° 34′
e′ : ō′=152° 56′

e′ : ŏ′=157° 43′
ē : T=143° 6′
ĕ : T=130° 6′
ē : ĕ(adjacent)=93°12′
ē : ā=149° 41′
ē : ō′=130° 32′
ĕ : ă=143° 18′
$e : e = \begin{cases} 93° 10' \\ 86° 50' \end{cases}$
e′ : M=117° 51′
e : *e′*=161° 16′
e : ā=146° 17′
e : ă=138° 58′
e′ : ō′=155° 28′

As these crystals (especially fig. 2.) afford a fine example of the method of crystallographic calculation in the monoclinate system, I here subjoin, for the assistance of such as may be interested in the study of Mathematical Crystallography, the several steps by which the above results have been obtained. In these explanations, I must necessarily make frequent references, for principles, to my System of Mineralogy.

We may select for this examination, figure 2. Assuming $\bar{a}$ as a face of the fundamental form, $M=\infty P\infty$, $P=\infty P'\infty$. The general descriptive expressions for the remaining planes are as follow:

$\bar{e}=mP\infty$ $\qquad e'=m'P'\infty$
$\breve{e}=-mP\infty$ $\qquad \bar{o}'=m'P'n$
$e=mP'\infty$ $\qquad e=\infty Pn$
$\breve{a}=-mP$ $\qquad e'=\infty Pn'$

The plane e ($mP'\infty$) forms parallel intersections, with $\bar{a}$ and $\breve{a}$, which intersections, since they are parallel with the edge $\bar{a}:M$ ($\infty P\infty$) are also parallel with the orthodiagonal edge of $\bar{a}$ (P.) Hence

$$\breve{a}=-P \text{ (§ 84, 2,) and } e=P'\infty \text{ (§ 84, 2.)}$$

and also since e forms parallel intersections with a and $-$a,

$$e=\infty P \text{ (§ 84, 1.)}$$

$\bar{e}$ truncates the edge between $\bar{a}$ and $\bar{a}$, which is the clinodiagonal edge of P, and therefore,

$$\bar{e}=P\infty \text{ (§ 84, 4.)}$$

$\breve{e}$ in the same manner truncates the clinodiagonal edge of $-$P. Consequently,

$$\bar{e}=-P\infty. \text{ (§ 84, 4.)}$$

The intersection of $\bar{o}'$ ($mP'n$) with $\bar{a}$ (P) is parallel to the clinodiagonal edge of P, (fig. 2.) consequently $n=m$ (§ 84, 8) and $\bar{o}'=mP'm$. Again $\bar{o}'$ forms parallel intersections with e ($P'\infty$) and e ($\infty P,$) and therefore its sign is of the general form $mP'\frac{m}{m-1}$, (§ 84, 9.) But from the above, $n=m$, and consequently $m=\frac{m}{m-1}$; from which we find $m=2$ and,

$$\bar{o}'=2P'2.$$

The edge $\bar{o}':e'$ ($mP'\infty$) is parallel to the orthodiagonal edge of $\bar{o}'$ (2P′2, fig. 2. b) consequently $m=2$ (§ 84, 2,) and

$$e'=2P'\infty.$$

The intersection of $\bar{o}'$ $(2P'2)$ with e' $(\infty P'n')$ is parallel to the basal section of $2P'2$ (apparent in the crystal, though not in the figure, a perspective representation of it;) hence $n'=2$ (§ 84, 1) and

$$e' = \infty P'2.$$

Thus all the expressions for the planes of this crystal have been determined without a measurement. If the intersection of $\bar{o}'$ with e were not apparent in the crystal, it would be necessary first to determine e' by measuring the interfacial angles $M : e$ and $M : e'$; these angles 136° 35′ and 117° 51′, diminished by 90° give the angles X in the two forms e $(P\infty)$ and e' $(\infty P'n';)$ and then since, $\tan 46° 35' = 2 \tan 27° 51'$, it follows that $n'=2$ and $e' = \infty P'2$. Thence since the intersection of $\bar{o}$ with e' is parallel to the basal section of $\bar{o}$ $(mP'm)$, $\bar{o} = 2P'2$ (§ 84, 1) as before found. The same might have been similarly determined by measuring the inclination of P on e and e′.

For the determination of $\bar{o}$ and $\breve{o}$ of fig. 3. we observe that $\bar{o}$, e, M, and $\breve{o}$ form parallel intersections with one another, which intersections are parallel to the orthodiagonal edge of $\bar{o}$ and $\breve{o}$; therefore $\bar{o} = mPm$ and $\breve{o} = -m'Pm'$. Again, $\bar{o}'$, $\bar{e}$ and the opposite e, form parallel intersections. Introducing therefore in the general equation for the parameters of planes forming parallel intersections, (§ 28.)

$$1,\ \infty,\ -1 \quad \text{for } m,\ n,\ r$$
$$m,\ 1,\ n \quad \text{for } m',\ n',\ r',$$
$$1,\ 1,\ \infty \quad \text{for } m'',\ n'',\ r''$$

we obtain $n = \frac{m}{m-1}$. But we have already determined that $n = m$, hence $m = \frac{m}{m-1}$ and $m = 2$; accordingly $\bar{o} = 2P2$. In the same manner it is found that $\breve{o} = -2P2$.

For the calculation of the dimensions and angles of the crystal we have as data, $\infty P\infty : P\infty = 140° 40'$, $\infty P\infty : -P\infty = 126° 8'$, $\infty P\infty : \infty P = 136° 35'$.

$180° - 140° 40' = 39° 20' = \mu'$ (Min. App. pp. 67. 68.)
$180° - 126° 8' = 53° 52' = \mu$
$136° 35' - 90° = 46° 35' = X$ in ∞P.

Since $P\infty$ and $-P\infty$ are coordinate forms, we may determine γ by the equation, $\tan \gamma = \frac{2 \sin \mu \sin \mu'}{\sin (\mu - \mu')}$ whence we obtain

$$\gamma = 76° 14' = C.$$

To determine the axes there are given the angles γ, μ, and X in ∞P. If $b=1$, $\tan X \sin \gamma = c$ (§ 82;) consequently

$$c=1.0265.$$

Again $a=\frac{\sin(\gamma+\mu)}{\sin \mu}=\frac{\sin 49^\circ\ 54'}{\sin 53^\circ\ 52'}$

therefore $a=\cdot 9471$

Hence $a:b:c=\cdot 9471 : 1 : 1\cdot 0265.$

After thus determining the axes, the angles X, Y, Z, in the various forms are readily obtained by the equations p. 68 or 69. For example, with regard to the form ±P. X and X′ may be determined by the equations $\tan X=\frac{\tan \pi}{\sin \mu'}$, $\tan X'=\frac{\tan \pi}{\sin \mu}$, $\tan \pi$ having first been found by the equation, $\tan \pi=\frac{c}{a}$. This gives $X=59^\circ\ 41'$ which is half the interfacial angle ā : ā. By means of the equations $\tan Y=\frac{\tan \mu'}{\sin \pi}$, $\tan Y'=\frac{\tan \mu}{\sin \pi}$, we obtain Y and Y′ which are respectively the supplemental angles of M on ā and M on ă. Again, by the equations, $\tan Z=\frac{\tan(\gamma-\mu')}{\sin \sigma}$, $\tan Z'=\frac{\tan(\gamma-\mu)}{\sin \sigma}$, ($\sigma$ being found by the equation $\sin \sigma=\frac{c}{b}$,) we find the angles Z, Z′ which are the supplements of T on ā and T on ă. $Y+Y'=$ the inclination of ā on ă over an orthodiagonal terminal edge, and $Z+Z'=$ the inclination of ā on ă over a basal edge of the form ±P.

In the form 2P′2 whose axes have the ratio, $2a$, $2b$, c, the angle μ is identical with the corresponding angle in P. π is found by the equation $\tan \pi=\frac{c}{2a}$, and σ by the equation $\tan \sigma=\frac{c}{2b}=\frac{c}{2}$. After the determination of these angles, X, Y, Z, in this form, may be found by the same equations as above. The inclination of T on *e* may be determined by the equation for tan Z, in the form ∞P, $\tan\left\{\frac{Z}{Z'}=\mp\frac{\tan \gamma \sqrt{(b^2+c^2)}}{c}\right.$, which affords the supplement of the desired inclination; or by the equation, $\sin \Pi$ (the sought angle) $=\frac{\cos X}{\cos \sigma}$, or $\cos \Pi=\sin X \cos \gamma$, in which X, is the angle X in the form *e* (∞P.) The interfacial angle e : M is determined by the equation for tan Y in P′ ∞.

In a similar manner the angles of the other forms may be obtained.

Art. VII.—*Address delivered at the Anniversary Meeting of the Geologicdl Society of London, on the 17th of February,* 1837; by Charles Lyell, Jun., Esq., M.A., F.R.S., President of the Society.

Gentlemen,—You will have learnt from the Treasurer's Report that the finances of the Society are flourishing, and they would have appeared in a still more prosperous condition, had we not expended above 500*l.* within the year on our Transactions. Part of this sum has already been repaid by the sale of the volume just published, of which I may safely say that it yields to no preceding number in the value of its contents or the extent and beauty of its illustrations.

The total number of Fellows of the Society, exclusive of Honorary and Foreign Members, at the close of the year 1835, was 670; at the close of 1836, 709; being an actual increase, after deducting 14 for deaths, removals, and resignations, of 39 Fellows.*

We have to lament the loss of Dr. Henry, of Manchester, so highly distinguished as a chemist and philosopher, and who took a warm interest in the progress of our science. Our list of Foreign Members has been diminished by two deaths, those of Professor Hoffman of Berlin, and Baron Férussac of Paris.

Professor Frederick Hoffman was suddenly cut off in his 39th year, at the moment when the scientific world were impatiently expecting his account of the Geology of Sicily. You are probably best acquainted with him as the author of the great Geological Map of Western Germany, in which he made known the results of many years of patient and accurate research. This Map, published in 1829, was divided into twenty-four sheets, and was followed in 1830 by an Atlas containing sections, and a more general map on a smaller scale of the same country. In the same year the author's Geography and Geology of North-western Germany appeared,† which may be regarded as a commentary on the great map, comprising a description of the physical outline of the country, its mountains, valleys, plains, and river-courses, and a sketch of a portion of its geological structure, embracing the transition and secondary rocks of the Hartz, Thuringerwald, and Lower Rhine. In the larger map all the tertiary and alluvial deposits are represented by one color, the author having never entered upon the subdivision and classification of these formations. He had studied, however, the newer secondary formations, which were depicted by several distinct colors, and their history would have been included in the work above alluded to, had he not been interrupted by his tour in Italy and Sicily in 1830.

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* The return of the number of Fellows, and the deaths alluded to in this Address, refer exclusively to the year 1836, and not to the period intervening between the last and present Anniversary.

† Orograph. und Geognost. Verhältnisse vom Nordwestlichen Deutschland, 2 vols. Leipzig, 1830.

Among his other writings, I may enumerate an Account of Magdeburg, Halberstadt, and the adjoining territory, and various papers which will be found scattered through the journals of Poggendorff and Karsten, the Hertha, and other German periodicals. The only fruits which we as yet possess of the scientific expedition sent by the Prussian Government under Hoffmann's direction to Italy and Sicily, are some letters written by him during the journey, and an excellent Memoir on the Lipari Islands; and a valuable work by one of his companions, Dr. Philippi of Berlin, who published in Latin a detailed account of the recent testacea of Sicily, and the tertiary fossil shells collected in the course of the expedition.*

From Hoffmann's letters it clearly appears that the novelty of the volcanic and tertiary phenomena of Southern Italy and Sicily had made a deep impression on his mind. He had been astonished, on recognising the identity of the modern trap rocks of the Val di Noto with those of ancient date in Germany, and the no less striking similarity of the Sicilian tertiary limestones, containing recent shells, to many calcareous secondary formations of northern Europe. The Lipari Islands afforded him a field for the examination of modern igneous rocks, and the slow effects of volcanic heat in modifying aqueous deposits. The picture which he has given of the fumeroles of the western coast of Lipari, the principal island of the group, is graphic and highly instructive. At St. Calogero numerous fissures are seen permeated by heated vapors which are charged with sulphur, oxide of iron, and other minerals, in a gaseous state. Here the tufaceous and other rocks are variously discolored wherever the steam has penetrated, and are sometimes crossed with ferruginous red stripes, so as to assume a chequered and brecciated appearance. In one place a feldspathic lava has been turned by the vapors into stone as white as chalk marl; in another, a dark clay has become yellow or snow-white, and these effects are not limited to a small space, but are seen extending for four miles through horizontal strata of tuff, which rise occasionally to the height of more than two hundred feet. The greater part however of the alterations are referred to what are properly called extinct fumeroles, or the action of volcanic emanations which have now ceased, but which must at one period have resembled those of St. Calogero. Some of these have produced veins of fibrous gypsum, calcedony, and opal, minerals which must have been introduced into the rents in a state of sublimation.

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* Phillippi, "Enumeratio Molluscorum Siciliæ tum viventium tum in tellure tertiaria fossilium, quæ in Itinere suo observavit Auctor:" 280 pages 4to, and 12 lithographic plates, Berlin, 1836.

In some places there are tufaceous marls, regularly alternating in thin beds, with still thinner and countless layers of granular gypsum, the whole mass being again run through every where by irregular branching veins of silky fibrous gypsum. These strata, thus insersected, present a perfect counterpart to some of the secondary gypseous marls, both of the keuper and variegated sandstone formations in Germany.*

When reading the Professor's description of these phenomena, we share in the pleasure and surprise which he felt on comparing strata of high antiquity with others of so recent a date, and which, moreover, owe a portion of that resemblance to changes now daily in progress.

The writings of Baron Daudebard de Férussac were not devoted principally to Geology, but we are indebted to him for several memoirs, and among others for an Essay, published in 1814, on freshwater formations, with a catalogue of the species of land and freshwater shells which were then known to enter into their composition. Monsieur de Férussac contributed largely to the Geological section of the Bulletin Universel des Sciences Naturelles, a journal, of which he was the chief editor and original projector. This Bulletin had, for its object, to give a monthly analysis or brief abstract, usually unmixed with criticism, of the contents of all new publications in every department of science. The work was first carried on for a year on a smaller plan, and then assumed in 1824 its enlarged and permanent form, being divided into eight sections, one of which was devoted to Geology, Palæontology, and Natural History. A monthly number appeared regularly, on this and each of the other seven sections, the whole forming together a large octavo volume. In the organization and direction of this scheme, the Editor was indefatigable, and he succeeded in obtaining the co-operation of a great number of the most able and eminent writers. In announcing the original aim and scope of the undertaking, he laid stress on the difficulties under which men of science labor in procuring intelligence of new works, written in a great variety of languages in different parts of the world, and frequently buried in the voluminous and costly transactions of learned societies. He therefore expressed a hope that his Bulletin would serve as "a kind of telegraph" for the rapid conveyance of the earliest intelligence of inventions and discoveries, so as to prevent philosophers from wasting their time and money in slowly feeling their way to results already found out by others, and attaining with great labor the very points from which they might have started. The Geological section of the Bulletin was ably supported by MM. Boué, Brongniart, and other writers, and survived the other sections for some time, maintaining itself for seven years, till at length it was given up in 1831 for want of sufficient encouragement.

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* Liparischen Inseln, p. 41. Leipzig, 1832.

The works of Baron Férussac on Natural History, and especially Conchology, would deserve from me a fuller notice, if they were not irrelevant to the subject of this address.

HOME GEOLOGY.

I shall now commence my retrospect of the proceedings of the Society, during the last year, by considering those papers which have been devoted to the Geology of the British Isles. There is probably no space on the globe, of equal area, which has been so accurately surveyed as this kingdom; yet the most experienced geologists are now exploring several parts of it with the feeling that they are entering upon terra incognita. Not only do they find it necessary to trace out more correctly the limits of formations previously known, but also to introduce new groups of fossiliferous strata and new divisions, in districts before supposed to have been well investigated.

The carboniferous deposits which are alike interesting, in a scientific and economical view, have deservedly occupied of late the particular attention of many able geologists, and we have received communications on the subject from Mr. Murchison, Mr. Prestwich, Professor Sedgwick, and Mr. Peile. The observations of Mr. Prestwich relate to the coal-measures of Coalbrook Dale, and the formations immediately above and below them, together with the accompanying trap-rocks.

There is perhaps no coal-field in the whole country of equal size in which the strata have been so much dislocated and shattered. Mr. Prestwich gives a detailed description both of the principal and minor faults, their direction, extent, inclination, breadth, and fall, and the difference of level produced by them in their opposite sides, which is sometimes slight, but sometimes amounts to six hundred or seven hundred feet. In some instances the change of level is by steps or hitches, which, it is truly said, may be owing either to unequal resistance, or to a series of small dislocations. The walls of the fissures in the disjointed strata are sometimes several yards apart, the interval being filled with the debris of the strata. In other places they are in contact. In this last case it is particularly remarked that the surface of the ends of the fractured beds of coal and shale is shining and striated. You are aware that this appearance has usually been attributed, and I believe rightly, to the rubbing of the walls of the rent one against the other, the lines of the polished and striated surfaces indicating the direction of the motion, but I have lately seen it objected to this theory, that the striæ are not always parallel, but often curved and irregular, and that the earthy contents of veins and faults often present the same glittering and striated faces, or slickensides as they have been called. I am familiar with the fact, and have always inferred that the movements were irregular and complicated, occasionally changing their direction, and that even when uniform, they may have acted unequally on materials varying in hardness and pliability. It is much to be desired that scientific travelers who visit countries shaken by earthquakes would observe with minute care all the phenomena attending the fissuring of rocks and buildings. I have been informed by an eye-witness of one of the late minor earthquakes in Chili, that the walls of his house were rent vertically, and made to vibrate for several minutes during each shock, after which they remained uninjured and without any opening, although the line of the crack was still visible. On the floor, at the bottom of each rent, was a small heap of fine brickdust, evidently produced by trituration. In such instances it would be desirable to obtain fragments of the rent building, and compare them with the walls of natural fissures.

In his examination of the fossils of the coal-measures, Mr. Prestwich has shown that beds containing marine remains alternate with others in which fresh-water shells and land plants occur, appearances which he attributes to the flowing of a river, subject to occasional freshes, into the sea, rather than to repeated changes in the relative level of land and sea.

It is certainly the safer course to incline to this hypothesis whenever there are no unequivocal signs, as in the Purbeck strata in Portland, of land plants having become fossil on the very spots where they grew. For although there may be many river deltas like that of the Indus, where the land is subject to be alternately upheaved above, and then let down below the waters of the sea, yet such oscillations of level must be considered as exceptions to the general condition of the earth's surface near the mouths of rivers at any given period. Even in a case like the delta of the Indus, both the causes above alluded to may be expected to co-operate in producing alternate fluviatile and marine strata; for in the long intervals between great movements of the land, the river will annually advance upon the sea with its turbid waters, and then retreat again as the periodical flood subsides, and the salt waters, after being driven back for a time, will re-occupy the area from which they have suffered a temporary expulsion.

In the conclusion of his valuable paper, Mr. Prestwich observes that the carboniferous strata of Coalbrook Dale must once have been entirely concealed under a covering of new red sandstone, and they owe their present exposure partly to those movements which have shattered and elevated the coal measures, and partly to extensive denudation. It is natural therefore to inquire how many other coal-fields may still lie buried beneath the new red sandstone of the adjoining district.

In relation to this point of great practical importance, Mr. Murchison formerly offered some conjectures, when speaking of the probable passage of the ten-yard coal of the Dudley field beneath the new red sandstone, which there flanks it on the east and west. That geologist now informs us that his conjectures have been verified, and that at Christchurch, one mile beyond the superficial boundary of the coal-field, the ten-yard and other seams have been reached by borings carried down to the depth of nearly three hundred yards. Adverting to this discovery, he directs attention to the possible extension of other carboniferous tracts beneath the surrounding new red sandstone of Shropshire, Worcestershire, Staffordshire, and other central counties.

It is clear that these geological considerations must be duly weighed by those who speculate on the probable future duration of British coal, according to the actual or any assumed rate of consumption.

Mr. Murchison, in describing the Dudley and Wolverhampton coal-fields, informs us that he has not yet found any fossil remains of decidedly marine origin, like those observed by Mr. Prestwich in Coalbrook Dale. The shells seem to be all of fresh water genera, and the *Megalichthys Hibberti*, and other fish occuring at Dudley, of species identical with those of the coal measures of Edinburgh, may have inhabited fresh water.

The same author has colored on an Ordnance map the superficial area of the Silurian rocks connected with the coal-fields above mentioned, and has shown that the Lickey quartz rock between Bromsgrove and Birmingham, of which the geological position has remained hitherto uncertain, is in fact nothing more than altered Caradoc sandstone, a member of the lower Silurian group. The same appears as a fossiliferous sandstone in one district, while in another, it passes into a pure quartz rock, a modification attributed to the proximity of underlying trap, for analogous changes have been seen at neighboring points where the absolute contact of the sandstone with the trap is visible.

We are also indebted to Mr. Murchison for some interesting remarks on the dislocations of the strata in the neighborhood of Dudley, and particularly for a description of some dome-shaped masses, from the center of which the beds have a quâquâversal dip. He speculates on the probable dependence of these phenomena upon the protrusion of volcanic matter from below, at points where it has been unable to find issue. It would, I think, have been more satisfactory, if, in confirmation of his theory, some natural section of one of these dome-shaped masses could be pointed out, where not only a nucleus of trap was apparent, but could be shown to have taken up its actual position in a soft or fluid state. Even if we should find in some instances a subjacent central mass of trap, porphyry or granite, not sending out veins or altering the strata, the folding of the beds round such a protuberance might admit of an explanation like that suggested by Dr. Fitton. He has supposed a set of yielding horizontal strata to be pressed upon by a subjacent hill or boss of hard rock, in which case the effect of upward pressure might resemble that seen, on a small scale, in the paper of a bound book, where a minute knob in one leaf has imparted its shape to a great number of other leaves without piercing through them.* Whatever hypothesis we favor, it is essential to observe that such hills as the Wren's nest near Dudley, and others of similar ellipsoidal forms and internal structure, do not correspond to the type of volcanic hills, such as Etna, Mount Dor, or the Cantal. In both cases there may be an approach to a cone, and the beds may dip every where outwards from a common centre; but, in the volcanic mountain, the beds having an outward dip, thin off as they approach the base or circumference of the cone, which is not the case in inclined beds composing the hills alluded to in the neighborhood of Dudley; nor in the last mentioned instances do the lowest or subjacent rocks crop out round the circumference of the cone, as happens in the instances of the volcanic eminences before alluded to, where the granite of the country round Mount Dor, the fresh-water beds and mica schist in the Cantal, the marine deposits around Mount Etna in Sicily,—each appear at the surface as soon as we have left the slope of the cone, and advance upon the surrounding low country.

In attempting to explain the principal transverse faults of the Dudley coal-field, Mr. Murchison refers frequently to the theoretical principles expounded by Mr. Hopkins in his Researches in Physical Geology, a paper printed in the sixth volume of the Transactions of the Cambridge Philosophical Society. Mr. Hopkins has there endeavored to develop, by reasoning founded on mechanical principles, and by mathematical methods, the effects of an elevatory force acting simultaneously at every point, beneath extensive portions of the crust of the earth. He is aware that in nature such a force must usually act under complicated conditions, so as to produce irregular phenomena; but he observes that in order to have a clear conception of the manner in which it would operate in producing movements and dislocations, it is useful to assume certain simple conditions to which mathematical investigations may be applied. When we have deduced in this manner some results free from all uncertainty, these may serve as standard cases to which the geologist may refer more complex problems. Thus for example, a portion of the earth's crust may be assumed to be of indefinite length, of uniform depth, and bounded laterally by two vertical parallel planes, beyond which the disturbing force does not extend. It is then supposed that a quantity of subterranean vapor or melted rock, existing at a certain depth, is expanded by heat so as to elevate the superincumbent mass, the resulting fissures in this mass may then become matters of calculation. According to Mr. Hopkins, rectilinear lines of dislocation will give rise to a set of longitudinal parallel fissures, and simultaneously to others precisely at right angles to them; whereas in conical elevations, the fissures will diverge from a centre. If the general axis of elevation be curvilinear, the longitudinal fissures preserving their parallelism with it will be also curvilinear, while the transverse fissures being perpendicular to the former at their points of intersection will no longer be parallel.

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* Dr. Fitton, Geol. Trans. 2nd Series, vol. iv. p. 244.

To return from this digression, I must now recall your attention to other papers relating to the carboniferous deposits of England. The coal-measures of the northwestern coast of Cumberland have been examined by Prof. Sedgwick and Mr. Williamson Peile, who have described the Whitehaven and other fields in great detail, illustrating their account with a map and sections. The recorded observations in numerous sinkings and borings, both in relation to the succession of the strata and to the complicated faults which intersect them, would have been involved in hopeless confusion, if they had simply consisted of a statistical collection of facts attested by miners; but in this paper, Prof. Sedgwick, aided by Mr. Peile's practical and scientific knowledge, has compared the different sections and generalized the phenomena, giving unity and consistency to the whole, throwing the strata into distinct groups, and referring the several faults to different movements, to which successive periods of time may be assigned.

In connection with these recent contributions to the history of our carboniferous strata, I am happy to mention the excellent volume lately published by Prof. Phillips, forming the second part of his Illustrations of the Geology of Yorkshire. It is almost entirely devoted to a description of the carboniferous or mountain limestone of Yorkshire and the north of England, a subject already admirably treated in some papers read before this Society by Prof. Sedgwick, particularly in his account of the carboniferous chain from Penigent to Kirkby Stephen.* As these geologists had separately explored the same ground, it is satisfactory to perceive that the leading divisions which they have proposed for the classification of the mountain limestone and associated strata, agree in every essential point. Mr.

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* Trans. Geol. Soc. 2nd Series, vol. iv. part 1. p. 69.—1835.

Phillips has described the physical geography of the district occupied by these rocks, their lithological character, stratification, jointed structure, and the most remarkable faults which affect them, especially those which have been called the great Penine and Craven faults. He also treats of the trap dykes which cut through the limestone, and discusses the probable epochs of the displacement of the strata, judiciously pointing out the difficulties unavoidably opposed to the rigorous determination of the date of such dislocations. A large and very valuable portion of the work is filled with descriptions and plates of organic remains, especially of the brachiopodous and cephalopodous mollusca. Most of the species of these classes were probably inhabitants of the deeper parts of the sea, but there are fossil shells in the mountain limestone, which the author supposes to have lived near the shore, and belonging to genera formerly regarded as foreign to the carboniferous limestone, such as Isocardia, Nucula, Pecten, Patella, Turritella, and Buccinum. Many species of Zoophytes and Crinoidea are also described and figured in this excellent monograph.

We are indebted to Mr. Austen for a description of the South of Devonshire between the river Ex and Berry Head, and between the coast and Dartmoor, a district consisting of transition rocks, new red sandstone, greenstone, and trap. His speculations on the origin of the different formations and the causes which gave rise to the existing features in the physical geography of the country, display much talent and are full of instruction.

The structure of Devonshire has also furnished a fertile field of inquiry to Messrs. Sedgwick and Murchison since our last anniversary. They have attempted the difficult task of establishing a classification of the older rocks so largely developed in that county. In every geological map hitherto published of Devonshire, all the stratified deposits of higher antiquity than the new red sandstone had been represented by one common color, the limestones being all included as integral parts of one great formation called greywacke.* But these gentlemen, after examining this region, announced at Bristol to the geologists assembled at the meeting of the British Association, that the great mass termed greywacke, and previously undivided, comprised in it several formations of great thickness, ranging in age from the Cambrian system of Prof. Sedgwick up to the true carboniferous series inclusive. The first groups mentioned by them in ascending order are the Cambrian and Lower Silurian, which great mass contains many distinct courses of limestone; and is separable into several formations, distinguishable from each other by stratigraphical position and by lithological and zoological characters.

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* The abstract of the Report of Messrs. Sedgwick and Murchison, published with a section in the Athenæum, August, 1836, and in other scientific journals, is the same as that written for insertion in the Proceedings of the Association. From that document, and from a written explanation of their views, which I obtained from the authors, the present observations are deduced.

There appears, however, to be a great hiatus in the succession of rocks in Devonshire, as compared to South Wales, there being no traces of the upper Silurian strata, nor of the old red sandstone, nor even of the mountain limestone in its ordinary aspect. On the contrary, the next group met with in ascending order, is a culmiferous series, the base of which distinctly reposes upon the above mentioned ancient rocks. This culmiferous deposit, far from appearing as a mere band, or at detached points, occupies about one third of the large county of Devon, and a considerable adjacent part of Cornwall; its southern boundary ranging from Exeter on the east, by Launceston, to St. Gennis in Cornwall on the west; its northern frontier running by Barnstable and and South Moulton to near Wellington in Somersetshire. These culmiferous beds are shown to contain thick beds of limestone; entirely dissimilar in structure and fossil contents from any limestones of the underlying "grauwacke," in which they had previously been merged. The culm measures consist of grit, sandstone, shale and limestone; and these rocks, it is said, are never affected by a slaty cleavage like the lower Silurian and Cambrian rocks on which they rest. From this character, as well as from their prevailing mineralogical structure and imbedded fossil plants, the authors regard the culmiferous formation of Devon as perfectly identical in age with other coal-fields, and as more particularly analogous to the culm-bearing strata of Pembrokeshire; a part of which also once passed for "grauwacke," but Mr. Murchison has recently shown that it belongs to the South Welsh coal-field, which is known by all geologists to rest upon mountain limestone.

Thus referred to the age of our ordinary coal, these strata of North Devon are further proved to lie in a great trough, their southern edges being turned up against the granite of Dartmoor, where they acquire, in contact with the granite, when traversed by elvan dykes, many characters of the metamorphic rocks, or those commonly termed primary. The phenomena of interference and alteration at the junction are such as to give a comparatively modern date for the eruption of the Dartmoor granite, and to explain why so much difficulty and ambiguity has prevailed in determining the age of some of the altered culm beds.

Among other points which this survey of Prof. Sedgwick and Mr. Murchison has settled, so far as Devon is concerned, is one of the highest theoretical interest, and on which for more than two years the Society has been anxiously desiring more accurate information; I allude to the true stratigraphical position of certain shales near Bideford in North Devon, containing fossil plants of the same species as those which are found abundantly in the coal. I may first remind you that a discussion had previously arisen respecting the alledged discovery by Mr. Weaver of anthracite, with the usual carboniferous plants, in the greywacke or transition rocks of Ireland.* Notwithstanding the value justly attached to the opinion of so experienced and long-practiced an observer, your Council hesitated to print his statement, and requested him to reexamine the ground. At the same time Mr. Griffiths, to whom we are looking for the publication of a Geological Map of Ireland, had come to a different conclusion, and Mr. Weaver having been induced to repeat his observations, became convinced that he was in error, and has since studiously availed himself of every opportunity of announcing this change in his views.

You are aware that as yet in the British islands, scarcely any vegetable impressions have been met with in rocks more ancient than the carboniferous strata above the old red sandstone, so that we know not what species of plants belong to the greywacke or transition group. We can only presume from analogy that since the shells, corals, and other organic remains of that ancient group differ from those found above the old red sandstone, the plants also, if ever discovered, will differ as greatly. Considerable surprise was therefore excited when, during the Presidentship of my predecessor in this chair, a letter was read, addressed to him from Mr. De la Beche, stating that he had found near Bideford in North Devon, many well known coal plants in the lower greywacke, or far down in the transition series.† Such of the plants as were determinable had been identified by Prof. Lindley with species characteristic of the true coal measures, and which had never been found elsewhere below the coal. The anomaly, therefore, in the supposed position of these fossils was so great, that between the ordinary geological site of such remains, and that in which they were here inferred to present themselves, there would be interposed, if the series were complete, the whole of the old red sandstone, and at least the two upper formations of the Silurian system. When this point was considered, I expressed to the Society my opinion in common with Mr. Murchison, as to the insufficiency of the proofs relied on by our Foreign Secretary, and we feel that we had a right to call for more conclusive evidence. The simple fact of shales having been found charged with true coal plants, raised so strong a presumption in favor of their belonging to the regular carboniferous series, that the burthen of proof rested with him who wished to assign to them either a higher or lower position. Our scepticism was regarded by Mr. Greenough as implying too marked a bias for a preconceived theory, and this he afterwards hinted in his anniversary address.* I may affirm, however, that in the first place it implied on my part no distrust of Mr. De la Beche's skill or experience in geological surveying, and that had Prof. Sedgwick and Mr. Murchison advanced a similar opinion on analogous proofs, I should equally have withheld my assent. Suppose, for example, they had announced to us that they had found fossil fruits and leaves identical with those of Sheppey in strata of the age of the white chalk with flints. I should have demanded from them, in corroboration, the most clear, unequivocal, and overwhelming evidence. If it were a region of disturbed and vertical strata, I should expect them first to have resorted in vain to every hypothesis of inverted stratification with a view of explaining away such an exception to the general rule.

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* Proceedings Geol. Soc., vol. i. p. 231.

† Proceedings Geol. Soc., vol. ii. p. 106.

I might perhaps be told that we are unacquainted with the flora of the upper cretaceous period, and I admit that we are as ignorant of it as of that which belonged to the transition period, but when we consider the contrast of the shells and other fossils of the chalk and London clay, we naturally anticipate that if plants are ever found of the precise age of our chalk with flints, they will not prove to be of the same species as those of the Sheppey clay. There is a like presumption from analogy against the conclusion that the same vegetation continued to flourish on the earth from the period of the lower greywacke to that of the coal, because we know that in the course of the intervening epochs the testacea, zoophytes, fish and other classes of organic beings were several times changed.

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* Proceedings Geol. Soc., vol. ii. p. 164.

In regard to the proofs relied on by Mr. De la Beche, I should observe that he never attempted to show that the plant-bearing shales at Bideford were interstratified with rocks charged with shells or other fossils known to belong to rocks older than the old red sandstone.

Since writing the above sketch of the different views recently published of the structure of Devonshire, I have received a letter from Mr. De la Beche, from which I am happy to learn that it is his intention before concluding his report on the Ordnance Map of Devon, to re-examine Devonshire. He is far, he says, from pretending that his first views were perfect, and if he finds reason to modify any of them, he shall not hesitate to announce the change of opinion. In the mean time he no longer contends that the culmiferous strata are referable to the lower greywacke, and considers the point of difference to lie within a narrower compass, namely, whether the culm beds are to be considered as upper greywacke or coal. This question, on which he is not yet satisfied, evidently appears to him of much less theoretical importance than, I confess, it does to me. It is fair, however, that I should state the arguments which influence his mind. If the plants, he says, found at Bideford in the culmiferous series should belong to strata more ancient than the old red sandstone, the fact would not stand alone, for he has lately received a letter from M. Elie de Beaumont, detailing analogous phenomena in Britanny. It is stated that the greywacke there closely corresponds in general character with that of Devon, the upper part like the Devonian series containing anthracite. With this anthracite or culm are found at Montrelais, Chatelaison, and other places, fossil plants, the greater part of which are identical with those in the coal measures; but there are others which have not hitherto been detected in the latter rock. Patches of true coal measures rest in unconformable position upon these upper greywacke beds of Britanny. Now I regret that I have not seen any printed account of the geology of this part of France; for until we learn whether the plants in question are associated with true Silurian fossils, the testimony is quite incomplete. We know not, for instance, whether the plant-bearing series in question, is old red sandstone or a Silurian formation, or whether it is a lower part of the true carboniferous system of which the strata had been disturbed before a higher portion was superimposed.

Similar remarks hold in regard to the observations made by M. Virlet in the Dictionnaire d'Hist. Naturelle, where in his late article "De l'Origine des Combustibles Minéraux," he speaks of certain carboniferous deposits of Ireland, (those alluded to by Mr. Weaver before mentioned,) as well as others examined by M. Voltz in the Black Forest, also the culm beds of Britanny, and those of the department of La Sarthe, as all belonging in age to the newest transition formations, "*terrains de transition les plus récens.*"

Mr. De la Beche alludes to another discovery of coal plants implying as great an anomaly as that which he had imagined to occur in Devonshire, and by which he was himself once led into error during an Alpine excursion, about eighteen years since, when he met with coal plants in the schists of the Col de Balme, in Switzerland. He then inferred that the beds belonged to the true coal measures, but M. Elie de Beaumont afterwards proved them to be lias; that is to say, he identified them with other rocks not far distant in the Alps, which were shown to be lias by containing Belemnites and other fossils. Mr. De la Beche was at first sceptical on the point, but after revisiting the Alps, he came round to the same opinion. Having therefore been in one instance misled by relying on the fossil vegetables of the coal as affording a good chronological test, he naturally attached but small value to the same testimony as a criterion of the age of another set of rocks in Devonshire. Now you will easily understand that a geologist, who is once persuaded that the same plants flourished in European latitudes from the period of the true coal to that of the lias, will be ready to concede without difficulty the probable existence of the same plants at an era long antecedent to the coal. We know that between the deposition of the coal and the lias there were successive revolutions in the races of animals which inhabited the waters; the zoophytes, mollusca, fish, and, as far as we know them, the reptiles having been changed again and again; so that the fossils of the mountain limestone differ from those of the magnesian limestone or zechstein, these again from the organic remains of the muschelkalk, and these last from those of the lias. If we are to believe that the same plants survived on the land, while such fluctuations in animal life occurred in the waters, why should we not imagine the longevity of the same species to have been still greater, so that they began to exist even before the deposition of the old red sandstone? But let me remind you that botanists have been led to very different conclusions respecting the laws governing the distribution of fossil vegetables from the study of undisturbed districts. You are not ignorant that the strata of the Alps are involved in extreme confusion and complexity, mountain masses having been completely overturned and twisted, so that the same set of strata have been found at the top and bottom of the same section separated by several thousand feet of beds belonging to an older formation. So obscure is the order of position in Alpine geology, that the cretaceous and greensand series have been classed by experienced geologists as more ancient than the oolite, under which, in point of fact, they occasionally lie.

Prof. Studer, in his work on the Bernese Highlands, after years of personal investigation, has published a map in which he has given a colored ground plan without venturing to commit himself by sections, or a table of the regular order of superposition.

After devoting a summer to the investigation of the same portion of Switzerland, with the advantage of Mr. Studer's map and work, I was unable to satisfy myself that I had found a key to the classification or superposition of the formations, so enormous is the scale on which they have been deranged. I collected fossil plants on the Col de Balme, but I have not examined the precise localities further to the west appealed to by M. de Beaumont. I am far, therefore, from denying his facts or inferences, hoping at some future period more carefully to inquire into the evidence on the spot. No one, I am aware, is more desirous that others should visit the southern Alps and verify or criticise his facts than M. de Beaumont. Meanwhile I am reminded of an expression of our mutual friend M. Von Buch. When I related to him some geological phenomena which surprised him; "I believe it," he said, "because you have seen it, but had I only seen it myself, I should not have believed it."

But to conclude, and to recall your attention to the structure of Devonshire, you will perceive that Mr. Murchison and Prof. Sedgwick have endeavored, and I think successfully, to work a great reform in the classification of the ancient rocks of that country, by applying to them the arrangement which they had previously made for the deposits termed by them Cambrian and Lower Silurian in Wales and the adjoining parts of England. According to their survey and sections, the coal plants of Bideford, so far from constituting any anomaly, so far from affording any objection to the doctrine that particular species of fossil plants are good tests of the relative age of rocks, do in reality from the place which they occupy, confirm that doctrine, culmiferous rocks distinctly overlying the so-called grauwacke, and not being referable to any of the well defined and normal types, which compose the old red sandstone and Silurian system.

I shall now pass on to the consideration of other memoirs on English Geology. The limestone which the Germans call muschelkalk, and the numerous fossils which are peculiar to it, have not yet been detected in England in any part of that great series of beds which intervene between the lias and the coal. In those parts of Germany where it occurs, it divides the beds of red marl and sandstone, which occupy that great interval into two divisions, the upper of which is called keuper, and the lower bunter sandstein. In the absence of the muschelkalk in this country, it has been impossible for us to separate our new red sandstone into two well defined masses; but Dr. Buckland considers that certain portions of the upper beds in Warwickshire and elsewhere may be identified with the keuper by their mineral character, and near Warwick by the remains of a Saurian, which he believes to be of the genus Phytosaurus, a genus characteristic of the keuper of Wirtemberg.

An examination in the South-east of England of the strata usually termed plastic clay, has led Mr. John Morris to offer several new, and as they appear to me, judicious suggestions in regard to the classification of these beds. It is well known that wherever the tertiary strata are seen in immediate contact with the chalk, they consist of alternations of sand, clay, and pebbles, and in some few places a calcareous rock,—all these varying greatly in their thickness and in their order of succession in different places. Mr. Morris divides those of Woolwich into two parts, and states that the upper is characterized by a mixture of marine and fresh-water shells, the fresh-water genera being Cyrena, Neritina, Melanopsis, and Planorbis. The lower division contains exclusively marine shells. The author refers this intermixture to the influx of a river into the sea, in which the London clay was formed. Mr. Morris considers the Bognor strata, which rest immediately upon chalk, as the equivalents of the lower Woolwich deposit, observing that the shells agree with those of the London clay. These remarks seem to confirm the conclusion to which he had been previously led by the grand section at Alum Bay in the Isle of Wight, namely that the beds usually styled plastic and London clays belong to one zoological period.

MINERAL VEINS.

Your attention has been called to the origin of mineral veins by Mr. Fox, who has endeavored to explain why so large a proportion of the metalliferous veins in England and other parts of the world should have an east and west direction. He supposes fissures filled with water, containing sulphurets and muriates of copper, tin, iron, and zinc in solution, through which currents of voltaic electricity are transmitted. The metals separated from their solvents by this action are deposited in the veins, and most abundantly in veins running at right angles to the direction of the earth's magnetism; for as the magnetic currents of the earth pass from north to south, they cause those of electricity to move east and west, although considerable deviations from this direction must be occasioned in the course of geological epochs by variations in the magnetic meridian.

Since Mr. Fox first ascertained the existence of electric currents in some of the metalliferous veins in Cornwall,* Mr. Henwood has made many experiments on the same subject, together with observations on the distribution of metallic and earthy minerals in veins. He considers the results obtained by him to be in a great degree opposed to the theory of Mr. Fox.†

Mr. Fox conceives the fissures in which metalliferous substances occur, to have been at first small and narrow, and to have increased gradually in their dimensions. This doctrine has also been propounded in a work with which you are probably familiar, and from which I have derived much instruction, I mean M. Fournet's Essay on Metalliferous Deposits. This Essay was originally included in the third volume of M. Burat's continuation of D'Aubuisson's Treatise on Geology, (1835,) but it is now published separately, and gives the clearest general view which I have seen of the application of geological theories to phenomena observed in mining. It is written by one who has acquired much practical knowledge as a miner, and who is well versed in chemistry and mineralogy.‡

Werner, when he published his justly celebrated Essay on Mineral Veins, had come to the conclusion that the same rent, after being wholly or partially filled, has sometimes been reopened; and M. Fournet has endeavored more fully to explain the successive dilatation of the same veins at distinct periods. He has given examples in mines worked under his direction at Auvergne, in which the sulphurets of iron, copper, lead, and zinc, besides quartz, barytes, and other minerals, seem evidently to have been introduced at different periods by chemical action accompanied by new fractures and dislocations of the rocks, and the widening of preexisting fissures.*

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* Phil. Trans. 1830, p. 399.

† See Mining Journal, Supplement 9. p. 34, December, 1836, and Annals of Electricity, No. 2. vol. i. on Electric Currents, &c. by W. T. Henwood, Esq.

‡ Etudes sur les Dépots Métallifères, par M. I. Fournet.

You will find in M. Fournet's treatise a copious analysis of a great variety of books on mining, besides a detail of facts which have fallen under his own observation. He has described first those veins which are decidedly connected with rents produced in rocks by mechanical movements, and which are supposed to have been chiefly filled from below by sublimation, more or less obviously connected with volcanic action. He afterwards passes on to the consideration of those masses which have been called stockwerks by the Germans, which are imagined by some to have their origin in the contraction of granite, porphyry, and other rocks as they cooled, numerous rents being then formed, in which metallic particles were concentrated. In treating the subject in this order the author appears to me to have followed the most philosophical course, beginning with cases of undoubted rents of mechanical origin filled with minerals and metals introduced by sublimation, and then carrying with him as far as possible the light derived from these sources to dissipate a part of the obscurity in which all theories respecting the nature of Plutonic rocks and their minerals must, I fear, be forever involved. Much will still remain unexplained; but those who proceed in an opposite direction often throw doubt and confusion upon the simplest phenomena, as has sometimes happened in an analogous case, when geologists have begun with the examination of granite and granite veins, and have then endeavored to apply the ideas derived from this study to the trap rocks and volcanic dykes.

Among the most interesting conclusions deduced by M. Fournet from his examination of the mining districts of Europe, I may mention the modern periods at which the precious metals appear to have entered into some veins: thus, to select a single example, some veins of silver of Joachimsthal in Bohemia are proved to have originated in the tertiary period.†

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* See "Etudes," &c. Section 3.

† See "Etudes," &c. Section 2.

FOREIGN GEOLOGY.

Among the researches into the geology of foreign countries in which our members have been recently engaged, I have great pleasure in alluding to the labors of Mr. H. E. Strickland and Mr. Hamilton in Asia Minor. These gentlemen first examined the neighborhood of Constantinople, and found on both sides of the Thracian Bosphorus an ancient group of fossiliferous strata, consisting of schist, sandstone, and limestone. From the character of the fossils it is inferred that these rocks may probably be the equivalents of the upper transition or Silurian strata of England. The shells belong to the brachiopodous genera Spirifer, Producta, and Terebratula, with which the remains of corals and Crinoidea were associated, and fragments of a Trilobite.

The rarity of any fossiliferous deposits of higher antiquity than the old red randstone in any of the countries bordering the Mediterranean, or indeed to the south of the Alps and Pyrenees, lends considerable interest to this observation. In their way through France, our travelers examined the well known region of extinct volcanos in Auvergne, and afterwards found a counterpart to it in the Catacecaumene, a district in Asia known by that name in the time of Strabo, from its burnt and arid appearance. Some of the volcanos in Asia are of very modern appearance, although no notice of their eruptions falls within the limits of history or tradition. The volcanic hills rise partly through lacustrine limestone in the valley of the Hermus, and partly cover the slope of the schistose hills which bound it to the south. There are about thirty older cones, worn by time, and of which the craters are effaced or only marked by a slight depression; and three newer cones, which preserve their characters unaltered, the craters being perfectly defined and the streams of lava still black, rugged, and barren. Here, as in the country of corresponding structure in France, we find streams of lava following the course of existing valleys, and yet frequently cut through by rivers. We find also a tertiary fresh-water formation, sometimes resembling chalk with flints, like that of Aurillac in France, and forming detached hills capped with basalt, while more modern lavas have flowed at the base of the same hills. The extent of this analogy will be best appreciated by those who compare Mr. Strickland's drawings with Mr. Poulett Scrope's masterly illustrations of the French volcanic region.

The countries watered by the rivers Meander and Cayster are described as having a simple geological structure. There are granitic rocks, with saccharine marble; there are also hippurite limestone and schist, and tertiary deposits unconformable to these, besides igneous rocks of various ages. The tertiary formations are chiefly lacustrine, and occur in nearly every large valley. They are composed of horizontal beds of calcareous marl and white limestone, in which are layers, and nodules of flint; they also consist of sandstone, sand, and gravel.

The only representative of the secondary rocks of Europe is termed by Mr. Strickland "hippurite limestone," which appears to be very sterile in fossils. In this respect and in its other characters it agrees with that great calcareous formation described by MM. Boblaye and Virlet in their splendid work on the Geology of the Morea.* According to these French geologists, three quarters of the Peloponnesus are occupied by a compact limestone several thousand feet thick, in which they could discover scarcely any organic remains, except a few hippurites and nummulites, but which is supposed to be the equivalent of our chalk and oolites. Nothing, they say, can be more monotonous in character than this calcareous mass in the South of Europe, which appears to represent the larger part of our upper secondary formations of the North, where the rocks are so varied in lithological aspect and so distinguishable from each other by their well preserved fossils.

Ancient fossiliferous strata resembling those of the neighborhood of Constantinople are said to be largely developed in the Balkan, a mountain chain of which we may soon expect to receive information from the pen of M. Ami Boué. That indefatigable geologist has already explored a large part of Servia, a country of whose physical and moral condition we are perhaps more ignorant than of any other in Europe, and he is rapidly extending his survey over various parts of the Turkish empire, to the examination of which he proposes to devote several years. Meanwhile our late secretary, Mr. Hamilton, is continuing, with great zeal, his investigation of the borders of the Black Sea and other parts of Asiatic Turkey.

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* Paris, 1833, in folio. It is to be regretted that this work cannot be procured separately from other folios containing the scientific information collected during the French expedition to the Morea.

In a paper on the structure of part of the Cotentin, near Cherbourg, the Rev. W. B. Clarke describes that country as consisting of hills or ridges of quartz rock alternating with valleys of slate occasionally associated with syenite and greenstone, which appear to be of posterior origin. A curious fact is mentioned: the quartz rock splits naturally into irregular masses, which have, nevertheless, some angles of fixed dimensions, namely, 103°, 64°, and 83°. Fragments of a green variety of schist exhibit the same angles under the same circumstances of position, proving that similar causes had acted on the two formations *en masse*, the same sets of joints, lines of stratification, and cleavage being found in both. Besides these facts, which are illustrated by diagrams, the author mentions others calculated to throw light on the cleavage and jointed structure of rocks.

PROOFS OF MODERN ELEVATION AND SUBSIDENCE.

Under this head I shall first consider several notices of beds of gravel, sand, clay, and marl, containing recent marine shells, which have been observed in various parts of Great Britain, a subject very frequently brought before our notice of late years. Deposits of this kind have been found by Dr. Scouler in the vicinity of Dublin, where they rise to the height of 80, and in some places of even 200 feet above the level of the sea. Besides marine shells of existing species, he has ascertained that some of the lower beds of this formation contain bones of the extinct Irish elk, by which we learn that this quadruped, although belonging to a comparatively modern period, and found in peat-mosses, had nevertheless begun to inhabit this part of the world at a period anterior to some of the last changes in the position of land and sea, changes which are proved by the upraised shelly beds just alluded to. Now Professor Nilsson of Lund in Sweden, although ignorant of these facts, had remarked to me that some great alteration must have occurred in the shape and extent of dry land and sea in Great Britain and the surrounding parts subsequently to the time when the Irish elk existed, otherwise so many entire skeletons of so large an herbivorous quadruped as the *Cervus megaceros*, would not have been found in so small an island as the Isle of Man. That island may at no remote geological period have been united to the main land, and may have since been separated from it by subsidences, on a scale equal to the elevations of which there is such clear evidence in Ireland and elsewhere.

Changes in the relative level of land and water, in the estuary of the Clyde, are indicated by facts described in another paper by Mr. Smith of Jordan Hill, near Glasgow. Superficial deposits, in which a great number of marine shells of recent species are imbedded, are found on the banks of the Clyde below Glasgow, at the height of thirty or forty feet above the sea. I had myself an opportunity of verifying during the last summer several of these observations of Mr. Smith, and found equally clear proofs that the Island of Arran had participated in the upward movement, so that a circle of inland cliffs may be traced all round that island, between the base of which and the present high-water mark a raised beach occurs, and in some places beds of marine marls, formed of recent shells, as in the bay of Lamlash. Mr. Smith has also traced sea-worn terraces on each side of the Clyde below Dumbarton and between the Cloch Lighthouse and Largs.

We are indebted to Sir Philip Egerton for some new details respecting the shelly gravel of Cheshire, of which he had previously treated; and to Mr. Murchison and Prof. Sedgwick for a joint paper on "a raised beach in Barnstable Bay on the northwest coast of Devonshire." This beach puts on for several miles where it is best exposed, the form of a horizontal under terrace resting upon an indented and irregular surface of the older formations. It presents a cliff towards the sea, in which beds of calcareous grit, sandstone, and shingle are seen perfectly stratified. The bottom of the deposit is chiefly composed of indurated shingles resting on the ledges of the older rocks, and filling up their inequalities. Through the whole cliff, but especially in the indurated grits, shells are abundantly dispersed, identical in species with those now living on the coast, and well preserved, though sometimes water-worn.

The authors point out that these beds cannot have been formed by accumulations of blown sand. They demonstrate an elevation of the coast during the modern period; and there are phenomena both on the north and south coasts of Devonshire and Cornwall, which afford proofs of modern changes in the level of the land, both of upheaval and depression. The raised beach of Hope's Nose, correctly described by Mr. Austen, is the most striking instance in South Devon.

The quantity of rise of land in the modern period is from ten to forty feet in South Devon and Cornwall, nearly seventy feet in North Devon, while in Lancashire, Cheshire, and Shropshire there are marine deposits with recent shells at the height of from three hundred to five hundred feet above the sea.

It is natural to inquire what changes the surface of the dry land in England may have undergone during the occurrence of such upward and downward movements. Perhaps some observations lately made by Mr. Bowerbank in the south of the Isle of Wight may elucidate this point. He has given us an account of a bed of chalky detritus, containing recent land shells, at Gore Cliff. This bed is ten feet thick, and rests immediately upon chalk marl. Many of the shells, which are plentifully scattered through it, retain their color. As the deposit ranges to the foot of St. Catherine's Down, it is possible that the waste and denudation of that chalk hill may have supplied the materials. I have lately seen similar detritus resting on the chalk with flints, and arranged in numerous thin layers in the section exposed in cutting the railroad at Winchester, where a black layer of peaty earth and carbonized wood intersects thin layers of white chalk rubble, from twenty to thirty feet thick. Such appearances are, in fact, very general in chalk districts; a bed of flints not water-worn occurring on the highest downs, while fragmentary chalk, often inclosing land shells, occurs on their slopes and at lower levels. Violent rains have been known even of late years to tear off the turfy covering from certain points near Lewes, and to wash away flints and chalky mud, and leave them in the hollow combs or flanks of the hills. This action of the elements would be most powerful at periods when the chalk first emerged from the sea, or whenever it assumed in the course of subterranean disturbances a new position or physical outline.

We must, I think, infer from the occurrence of certain recent marine shells and shingles in the bottom of what has been termed the elephant-bed at Brighton, that the chalk in the Southeast of England has undergone some movements of a modern date, the land having subsided there to the depth of fifty or sixty feet, and having been subsequently raised up again to a level somewhat higher than its original position.*

If it should appear upon careful research that that the land shells found in terrestrial alluviums covering the chalk are almost universally of recent species, I should not conclude that the emergence of the chalk hills from the sea had generally occurred at a very modern period, but merely that these hills had been modified in shape in recent times, and that during that modification, alluviums of older date had been washed away, or the land shells which they may once have contained have decomposed and disappeared. In regard to the great numbers of these shells preserved throughout the bed at Gore Cliff, and in many other places even at greater depths, it will not seem surprising to those who have observed the number of dead land shells which are strewed over the surface of the chalk downs, or lie concealed in the green turf in numbers almost as countless as the blades of grass. If the slightest wash of water should pass over such a soil, it must float off myriads of these shells, and they would immediately be involved in that white cream-colored mud which descends from wasting hills of chalk after heavy rains. Land shells so buried may retain their color for indefinite periods, as is shown by the state of species in the loess of the Rhine, and even in tertiary strata of much higher antiquity.

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* See Principles of Geology, 4th edit., vol. iv. p. 274.

While a variety of geological monuments are annually discovered which attest modern alterations in the level of the land, it is important to remark that new testimony is also daily obtained of the rising and sinking of land in our own times. I discussed at some length, in my last anniversary address, the evidence for and against the upheaval of the coast of Chili during the earthquake of 1822, a controverted point to which our attention has lately been again recalled. I may remark, however, that since we have ascertained the fact of a rise of three, five, and even ten feet in parts of the same country in 1835, so distinctly attested by Captain Fitzroy, all doubts entertained as to the permanent effects of a preceding convulsion are comparatively of small interest. Don Mariano Rivero dissents from the opinion that a change of level occurred at Valparaiso in 1822, and Colonel Walpole, after seeing the ground and conversing with persons who were on the spot in 1822, and who still reside there, also considers the statement of a rise to be inaccurate. On the other hand Mr. Caldcleugh, who was formerly sceptical on the same point, has now come round to the opinion of Mrs. Calcott, (Maria Graham,) and believes that an elevation of land did take place.

Mr. Darwin, whose opportunities of investigation both in Chili and other parts of South America have been so extensive, thinks it quite certain that the land was upheaved two or three feet during the earthquake of 1822, and he met with none of the inhabitants who doubted the change of level. He states that the rise of land, even in the bay of Valparaiso, was far from being uniform, for a part of a fort not formerly visible from a certain spot has, subsequently to the earthquake, fallen within the line of vision. The most unequivocal proof of a recent rise is drawn from the acorn-shells, *Balanidæ*, found adhering to the rock above the reach of the highest tides. These were observed by Mr. Darwin sixty miles south of Valparaiso, and at Quintero, a few miles to the north of it; but his friend Mr. Alison detected them on a projecting point of rock at Valparaiso itself. The attached shells were there seen at the height of fourteen feet above high-water mark, and were only exposed upon the removal of the dung of birds, by which they would have been concealed from ordinary observation. In Mr. Darwin's paper you will find many other facts elucidating the rise of land at Valparaiso, and he has also treated of the general question of the elevation of the whole coast of the Pacific from Peru to Terra del Fuego. Beds of shells were traced by him at various heights above the sea, some a few yards, others five hundred or even thirteen hundred feet high, the shells being in a more advanced state of decomposition in proportion to their elevation. Mr. Darwin also shows that parallel terraces such as those of Coquimbo, described by Captain Basil Hall and others, which rise to the height of three hundred feet and more, are of marine origin, being sometimes covered with sea-shells, and they indicate successive elevations. There are also grounds for believing that the modern upheaval of land has proceeded not only by sudden starts during convulsions of the earth, but also by insensible degrees in the intervals between earthquakes, as is now admitted to be the case in parts of Norway and Sweden.

This gradual and insensible rising is supposed to affect, not only the region of the Andes, but also the opposite or eastern coast of South America, where earthquakes are never experienced: for the Pampas of Buenos Ayres bear marks of having risen to their present height during a comparatively modern period, while the coast line of the Pacific, or the region of earthquakes and volcanic eruptions, has been the theater of more violent movements.

It is curious to reflect that if in one portion of a large area of the earth's surface a rise of land takes place at the rate of a few inches in a century, as around Stockholm, while in another portion of the same area land is uplifted about a yard during an equal period, there will be caused, if sufficient time be allowed, a group or chain of lofty mountains in one place, and in the other a low country like the Pampas of South America.

Evidence of a sinking down of land, whether sudden or gradual, is usually more difficult to obtain than the signs of upheaval. I shall therefore mention some facts which have been lately communicated to me by Professor Nilsson, from which it appears that Scania, or the southernmost part of Sweden, has been slowly subsiding for several centuries, in the same manner as was lately shown to be the case with part of Greenland. In the first place there are no elevated beds of recent marine shells in Scania, like those near Stockholm and further to the north. Linnæus, with a view of ascertaining whether the waters of the Baltic were retiring from the Scanian shore, measured in 1749 the distance between the sea and a large stone near Trelleborg. Now Mr. Nilsson informs me that this same stone is a hundred feet nearer the water's edge than it was in Linnæus's time, or eighty-seven years before. He also states that there is a submerged peat moss, consisting of land and fresh-water plants, beneath the sea at a point to which no peat could have been drifted down by any river. But what is still more conclusive, it is found that in sea-port towns, all along the coast of Scania, there are streets below the high-water level of the Baltic, and in some cases below the level of the lowest tide. Thus when the wind is high at Malmö the water overflows one of the present streets, and some years ago some excavations showed an ancient street in the same place eight feet below, and it was then seen that there had evidently been an artificial raising of the ground, doubtless in consequence of that subsidence. There is also a street at Trelleborg and another at Skanör a few inches below high-water mark, and a street at Ystad is just on a level with the sea, at which it could not have been originally built. I trust that we shall soon receive more circumstantial details of these curious phenomena, which are the more interesting because it has been shown that the elevatory movement in Sweden diminishes in intensity as we proceed southward from the North Cape to Stockholm, from which it seems probable that after passing the line or axis of least movement, where the land is nearly stationary, a movement may be continued in an opposite direction, and thus cause the gradual sinking of Scania.

I cannot take leave of this subject without remarking that the occurrence in various parts of Ireland, Scotland, and England, of recent shells in stratified gravel, sand, and loam, confirms the opinion which I derived from an examination of part of Sweden, namely, that the formations usually called diluvial have not been produced by any violent flood or débacle, or transient passage of the sea over the land, but by a prolonged submersion of the land, the level of which has been greatly altered at periods very modern in our geological chronology. I now believe that by far the greatest part of the dispersion of transported matter has been due to the ordinary moving power of water, often assisted by ice, and cooperating with the alternate upheaval and depression of land. I do not mean wholly to deny that some sudden rushes of water and partial inundations of the sea have occurred, but we are enabled to dispense with their agency more and more in proportion as our knowledge increases.

ORGANIC REMAINS.

Gentlemen, you have been already informed that the Council have this year awarded two Wollaston Medals, one to Captain Proby Cautley of the Bengal Artillery and the other to Dr. Hugh Falconer, Superintendent of the Botanic Garden at Saharunpore, for their researches in the geology of India, and more particularly their discovery of many fossil remains of extinct quadrupeds at the southern foot of the Himalaya mountains. At our last anniversary I took occasion to acknowledge a magnificent present, consisting of duplicates of these fossils, which the Society had received from Captain Cautley, and since that time other donations of great value have been transmitted by him to our museum. These Indian fossil bones belong to extinct species of herbivorous and carnivorous mammalia, and to reptiles of the genera crocodile, gavial, emys, and trionyx, and to several species of fish, with which shells of fresh-water genera are associated, the whole being entombed in a formation of sandstone, conglomerate, marl, and clay, in inclined stratification, composing a range of hills called the Siwâlik, between the rivers Sutledge and Ganges. These hills rise to the height of from five hundred to a thousand feet above the adjacent plains, some of the loftiest peaks being three thousand feet above the level of the sea.

When Captain Cautley and Dr. Falconer first discovered these remarkable remains their curiosity was awakened, and they felt convinced of their great scientific value; but they were not versed in fossil osteology, and being stationed on the remote confines of our Indian possessions, they were far distant from any living authorities or books on comparative anatomy to which they could refer. The manner in which they overcame these disadvantages, and the enthusiasm with which they continued for years to prosecute their researches when thus isolated from the scientific world is truly admirable. Dr. Royle has permitted me to read a part of their correspondence with him when they were exploring the Siwalik mountains, and I can bear witness to their extraordinary energy and perseverance. From time to time they earnestly requested that Cuvier's works on osteology might be sent out to them, and expressed their disappointment when, from various accidents, these volumes failed to arrive. The delay perhaps was fortunate, for being thrown entirely upon their own resources, they soon found a museum of comparative anatomy in the surrounding plains, hills, and jungles, where they slew the wild tigers, buffalos, antelopes, and other Indian quadrupeds, of which they preserved the skeletons, besides obtaining specimens of all the genera of reptiles which inhabited that region. They were compelled to see and to think for themselves while comparing and discriminating the different recent and fossil bones, and reasoning on the laws of comparative osteology, till at length they were fully prepared to appreciate the lessons which they were taught by the works of Cuvier. In the course of their labors they have ascertained the existence of the elephant, mastodon, rhinoceros, hippopotamus, ox, buffalo, elk, antelope, deer, and other herbivorous genera, besides several canine and feline carnivora. On some of these Dr. Falconer and Captain Cautley have each written separate and independent memoirs. Captain Cautley for example, is the author of an article in the Journal of the Asiatic Society, in which he shows that two of the species of mastodon described by Mr. Cliff are, in fact, one; the supposed difference in character having been drawn from the teeth of the young and adult of the same species. I ought, to remind you that this same gentleman was the discoverer in 1833 of the Indian Herculaneum or buried town near Behat, north of Seharunpore, which he found seventeen feet below the surface of the country when directing the excavation of the Doab Canal.*

But I ought more particularly to invite your attention to the joint paper by Dr. Falconer and Captain Cautley on the Sivatherium, a new and extraordinary species of mammalia, which they have minutely described and figured, offering at the same time many profound speculations on its probable anatomical relations. The characters of this genus are drawn from a head almost complete, found at first enveloped in a mass of hard stone, which had lain as a boulder in a water-course, but after much labor, the covering of stone was successfully removed, and the huge head now stands out with its two horns in relief, the nasal bones being projected in a free arch, and the molars on both sides of the jaw being singularly perfect. This individual must have approached the elephant in size. The genus Sivatherium, say the authors, is the more interesting, as helping to fill up the important blank which has always intervened between the ruminant and pachydermatous quadrupeds, for it combines the teeth and horns of a ruminant, with the lip, face, and probably proboscis of a pachyderm. They also observe, that the extinct mammiferous genera of Cuvier were all confined to the Pachydermata, and no remarkable deviation from existing types had been noticed by him among fossil ruminants, whereas the Sivatherium holds a perfectly isolated position, like the giraffe and the camels, being widely remote from any other type.

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* Journ. of Asiatic Society, Nos. xxv. and xxix. 1834. Principles of Geology, 4th and subsequent editions. See Index, Behat.

I have not space to enter upon the warm discussion which has arisen in France between MM. Blainville and Geoffroy St. Hilaire respecting the amount of analogy which exists between the Sivatherium and the Giraffe, but I observe with pleasure that in the course of that controversy those distinguished naturalists do justice to the zeal and talents displayed by our countrymen Captain Cautley and Dr. Falconer, and to the services which they have rendered to science.

While these discoveries were made on the banks of the tributaries of the Indus and the Ganges, Mr. Darwin was employed in collecting the bones of large extinct mammalia, near the banks of the Rio Plata, in the Pampas of Buenos Ayres and in Patagonia. Mr. Owen has enabled me to announce to you in a few words some of the most striking results which he has obtained from his examination of the specimens liberally presented by Mr. Darwin to the College of Surgeons, and of which casts will soon be made for our own and other public museums. In the first place, besides a cranium with teeth of the Megatherium, Mr. Darwin has brought home portions of another animal as large as an ox, and allied to the Megatherium. Fragments of its armor are preserved, as well as its jaws, femur, and other bones. There is also a third creature of the order Edentata, and belonging to this same family of Dasypodidæ, in the shape of a gigantic Armadillo, as large as a Tapir. Of the ruminant order there is also a no less remarkable representative in the remains of a gigantic Llama from the plains of Patagonia, which must have been as large as a camel and with a longer neck: and lastly, of the Rodentia there is the cranium of a huge animal of the size of a rhinoceros, with some modification in the form of the skull resembling that in the Wombat.

These fossils, of which a description will shortly be given to the Society by Messrs. Clift and Owen, establish the fact that the peculiar type of organization which is now characteristic of the South American mammalia has been developed on that continent for a long period, sufficient at least to allow of the extinction of many large species of quadrupeds. The family of the armadillos is now exclusively confined to South America and here we have from the same country the Megatherium, and two other gigantic representatives of the same family. So in the Camelidæ, South America is the sole province where the genus Auchenia or Llama occurs in a living state, and now a much larger extinct species of Llama is discovered. Lastly, among the rodents, the largest in stature now living is the Capybara, which frequents the rivers and swamps of South America and is of the size of a hog. Mr. Darwin now brings home from the same continent the bones of a fossil rodent not inferior in dimensions to the rhinoceros.

These facts elucidate a general law previously deduced from the relations ascertained to exist between the recent and extinct quadrupeds of Australia; for you are aware that to the westward of Sydney on the Macquarie River, the bones of a large fossil kangaroo and other lost marsupial species have been met with in the ossiferous breccias of caves and fissures.

A cavern has lately been examined at Yealm Bridge, six miles south-east from Plymouth, by one of our members, Lieut. Col. Mudge, R. E., from whose account it appears that the bones of hyenas are very numerous there. They are associated with those of the elephant, rhinoceros, horse, and other animals usually found in caves. The number of fossil Carnivora, such as the hyena, wolf, fox, and bear, which have now been met with in districts of cavernous limestone in Great Britain, is so great, that we are the more struck with the rarity and general absence of such remains in surrounding and intervening districts, over which the same beasts of prey must have ranged. The Pachydermata, as the elephant, rhinoceros, and hippopotamus, are often discovered in ancient alluvial or fluviatile deposits; but had there been no caves and fissures we should scarcely have obtained any information respecting the existence of lions, tigers, hyenas, and other beasts of prey which inhabited the country at the same period.

The remains of at least two distinct Saurian animals have been discovered by Dr. Riley and Mr. Samuel Stutchbury, in the dolomitic conglomerate of Durdham Down near Bristol. They are allied to the Iguana and Monitor, but the teeth, vertebræ, and other bones exhibit characters by which they are seen to be generically distinct from all existing reptiles. They are particularly deserving of your attention as occurring in the bottom of the magnesian limestone formation, the oldest strata in which the bones of reptiles have as yet been found in Great Britain. The most ancient examples of fossil reptiles known on the continent of Europe, occur also in the zechstein of Germany, a formation of about the same age.

I alluded last year to a memoir of Sir Philip Egerton's, in which he pointed out some peculiarities in the structure of the cervical vertebræ of the Ichthyosaurus. He has now proved that in all the species of this genus there are three accessory bones, which he proposes to call, from their shape and position, subvertebral wedge bones. They are supplementary to the atlas, axis, and third vertebra of the neck, and seem to have escaped the observation of Cuvier and other osteologists.

Mr. Lewis Hunton has communicated to the Society an elaborate account of a section of the upper lias and marlstone in Yorkshire, showing that different beds in those formations are characterized by particular species of Ammonites and other Testacea, each species having a limited vertical range. His observations are valuable not only as illustrating the distribution of fossils on the coast near Whitby, but also as furnishing a point of comparison between that district and many others in Great Britain. Mr. W. C. Williamson of Manchester has had the same object in view in studying the fossils of the oolitic formations of the coast of Yorkshire, and informs us, as the result of his patient investigation, that although certain assemblages of fossils abound in particular subdivisions of the oolite, many species range from the lowermost to nearly the highest beds. This inference is confirmed when we compare the lists drawn up by Mr. Williamson, and those published by Prof. Phillips and other competent authorities. Thus some of the shells of the inferior oolite, mentioned in Mr. Williamson's list (*Trigonia gibbosa*, for example,) occur also in the Portland stone of Wiltshire; another, as *Ostrea Marshii*, is characteristic of the cornbrash in the same county; others pass downwards to the lias, as *Orbicula reflexa* and *Ammonites striatulus*. If you consult the tables of organic remains which

Dr. Fitton has annexed to his excellent monograph on the strata below the chalk, just published in our Transactions, (2nd Series, vol. iv. part 2.) you will see that a considerable number of shells pass from the upper oolitic groups into the green-sand. We are not to conclude from these facts that certain sets of fossils may not serve as good chronological tests of geological periods, but we must be cautious not to attach too much importance to particular species, some of which may have a wider, others a more limited vertical range. The phenomena alluded to are strictly analogous to those with which we are familiar in the more modern deposits where different tertiary formations contain some peculiar Testacea, together with others common to older or newer groups, or where shells of species now living in the sea are associated with others that are extinct.

An assemblage of fossil shells has been presented to our museum by Mr. J. Leigh and Mr. J. W. Binney, found at Collyhurst near Manchester, in red and variegated marls, which were referred by them at first to the upper division of the new red sandstone group; but Professors Sedgwick and Phillips consider them to be a red and variegated deposit, belonging to the magnesian limestone series. As these fossils are new and characteristic of a particular subdivision of the beds between the lias and coal, it is to be hoped that they will soon be described and figured.

The petrifaction of wood, and more especially its silicification still continues to present obscure problems to the botanist and chemist. The first step towards their solution will probably be made by carefully examining vegetables in different stages of petrifaction, and with this view Mr. Stokes has procured several specimens of wood, partly mineralized and partly not. Among these is a piece found in an ancient Roman aqueduct in Westphalia, in which some portions are converted into spindle-shaped bodies consisting of carbonate of lime: while the rest of the wood remains in a comparatively unchanged state. The same author has pointed out cases both of siliceous and calcareous fossils, where the lapidifying process must have commenced at a number of separate points, so as to produce spherical or fusiform petrifactions, independent of each other, in which the woody structure is apparent, while in the intervening spaces the wood has decayed, having after removal been replaced by mineral matter. In some petrifactions, the most perishable, in others the most durable portions of plants are preserved, variations which doubtless depend on the time when the mineral matter was supplied.

If introduced immediately on the first commencement of decomposition, then the most destructible parts are lapidified, while the more durable do not waste away till afterwards, when the supply has failed, and so never become petrified. The converse of these circumstances gives rise to exactly opposite results. As to the manner in which the minutest pores and fibres discoverable by the microscope, even the spiral vessels themselves, can be turned into stone, or have their forms faithfully represented by inorganic matter, no satisfactory explanation has ever yet been offered. In considering, however, this question, you will do well to consult the important suggestion which a celebrated chemist, our late lamented Secretary, Dr. Turner, has thrown out on the application of chemistry to geology. He reminds us that whenever the decomposition of an organic body has begun, the elements into which it is resolved are set free in a state peculiarly adapting them to enter into new chemical combinations. They are in what is technically termed a nascent state, the constituent molecules being probably of extreme smallness and in a fluid or gaseous form, ready to obey the slightest impulse of chemical affinity, so that if the water percolating a stratum be charged with mineral ingredients, and come in contact with elements thus newly set free, a mutual action takes place, and new combinations result, in the course of which solid particles are precipitated so as to occupy the place left vacant by the decomposed organic matter. In a word, all the phenomena attendant on slow putrefaction must be studied whenever we attempt to reason on the conversion of fossil bodies into stone; and in regard to silicification, Dr. Turner has shown how great a quantity of silex is set free as often as felspar decomposes, and how abundantly siliceous matter may be imparted from this source alone to running water throughout the globe.

As I have mentioned the name of Dr. Turner, I cannot pass on without an expression of sorrow for the untimely death of that amiable and distinguished philosopher. Mr. Whewell in most feeling terms alluded this morning at the general meeting to this melancholy event, which is too recent and too painful to myself and others to allow me now to dwell longer upon it.

Before quitting the subject of vegetable petrifactions, I ought to mention a memoir just published, by Mr. H. R. Göppert, Professor of Botany at Breslau, "On the various Conditions in which Fossil Plants are found, and on the Process of Lapidification."* He has instituted a series of most curious experiments, and his success in producing imitations of fossil petrifactions has been very remarkable. I have only space to allude to one or two examples. He placed recent ferns between soft layers of clay, dried these in the shade, and then slowly and gradually heated them, till they were red hot. The result was the production of so perfect a counterpart of fossil plants as might have deceived an experienced geologist. According to the different degrees of heat applied, the plants were obtained in a brown or perfectly carbonized condition, and sometimes, but more rarely, they were in a black shining state, adhering closely to the layer of clay. If the red heat was sustained until all the organic matter was burnt up, only an impression of the plant remained.

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* Poggendorff, Annalen der Physik und Chemie, vol. xxxviii. part 4. Leipsic, 1836.

The same chemist steeped plants in a moderately strong solution of sulphate of iron, and left them immersed in it for several days until they were thoroughly soaked in the liquid. They were then dried and kept heated until they would no longer shrink in volume, and until every trace of organic matter had disappeared. On cooling them he found that the oxide formed by this process had taken the form of the plants. Prof. Göppert then took fine vertical slices of the Scotch fir, *Pinus sylvestris*, and treated them in the same way; and so well were they preserved, that, after heating, the dotted vessels so peculiar to this family of plants were distinctly visible. A variety of other experiments were made by steeping animal and vegetable substances in siliceous, calcareous, and metallic solutions, and all tended to prove that the mineralization of organic bodies can be carried much farther in a short time than had been previously supposed.

These experiments seem to open a new field of inquiry, and will, I trust, soon be repeated in this country. In endeavoring, however, to verify them, the greatest caution will be required, or we may easily be deceived. We must ascertain, for example, with certainty that every particle of animal or vegetable matter is driven off before we attempt to determine the full extent to which mineralization may have proceeded. Prof. Göppert is doubtless aware that coniferous wood may be burnt and reduced to charcoal, and after having been kept for some time at a red heat, will continue to exhibit, on being cooled, the discs or reticulated structure to which he alludes. If, therefore, some small particles of carbon remain in the midst of the oxide of iron, such portions may retain traces of the vessels peculiar to coniferous wood; and an observer not on his guard, might infer that the same structure was preserved throughout the mass.

In my last address, I alluded to Mr. Lonsdale's detection of vast numbers of microscopic corallines and minute shells in the substance of the white chalk of various counties in England, where this rock had not been suspected of consisting of recognizable organic bodies. I cannot deny myself the pleasure of mentioning the still more singular and unexpected facts brought to light during the last year, by Prof. Ehrenberg of Berlin, respecting the origin of tripoli. I need scarcely remind you, that tripoli is a rock of homogeneous appearance, very fragile and usually fissile, almost entirely formed of flint, and which was called polir-schiefer, or polishing slate, by Werner, being used in the arts for polishing stones or metals. There have been many speculations in regard to its origin, but it was a favorite theory of some geologists that it was a siliceous shale hardened by heat. The celebrated tripoli of Bilin in Bohemia consists of siliceous grains united together without any visible cement, and is so abundant that one stratum is no less than fourteen feet thick. After a minute examination of this as well as of the tripoli from Planitz in Saxony, and another variety from Santa Fiora in Tuscany, and one from the Isle of France, Ehrenberg found that the stone is wholly made up of millions of siliceous cases and skeletons of microscopic animalcules. It is probably known to you, that this distinguished physiologist has devoted many years to the anatomical investigation of the infusoria, and has discovered that their internal structure is often very complicated, that they have a distinct muscular and nervous system, intestines, sexual organs of reproduction, and that some of them are provided with siliceous shells, or cases of pure silex. The forms of these durable shells are very marked and various, but constant in particular genera and species. They are almost inconceivably minute, yet they can be clearly discerned by the aid of a powerful microscope, and the fossil species preserved in tripoli are seen to exhibit in the family Bacillaria and some others the same divisions and transverse lines which characterize the shells of living infusoria.

In the Bohemian schist of Bilin, and in that of Planitz in Saxony, both of them tertiary deposits, the species are fresh-water, and are all extinct. The tripoli of Cassel appears to be more modern, and the infusoria in that place, which are also fresh-water, are some of them distinctly identical with living species, and others not. In the tripoli brought from the Isle of France, the cases or shells all belong to well-known recent marine species.

The flinty shells of which we are speaking although hard are very fragile, breaking like glass, and are therefore admirably adapted when rubbed for wearing down into a fine powder fit for polishing the surface of metals. It is difficult to convey an idea of their extreme minuteness, but I may state that Ehrenberg estimates that in the Bilin tripoli there are 41,000 millions of individuals of the *Gaillonella distans* in every cubic inch of stone. At every stroke therefore of the polishing stone we crush to pieces several thousands if not myriads of perfect fossils.

Gentlemen,—Although I have already extended this address beyond the usual limits, I cannot conclude without congratulating you on the appearance of Dr. Buckland's Bridgewater Treatise, a work in the execution of which the author has most skilfully combined several distinct objects. He has briefly explained the manner in which the materials of the earth's crust are arranged, and the evidence which that arrangement affords of contrivance, wisdom, and foresight. He has also given us a general view of the principal facts brought to light by the study of organic remains; thus contributing towards the filling up one of the greatest blanks which existed in the literature of our science, while at the same time he has pointed out the bearing of these phenomena on natural theology.

He has shown that geology affords one kind of testimony perfectly distinct from natural history, of the adaptation of particular means and forces to the accomplishment of certain ends for which the habitable globe has been framed. These proofs are illustrated in the author's chapters on the origin and mechanism of springs, on the distribution of metallic and other minerals in the earth, and the position of coal in stratified rocks. In reference to these points it is demonstrated that some even of the most irregular forces have produced highly beneficial results, in modifying the subterranean economy of the globe. But I shall not dwell on this part of the Treatise, but pass on at once to that which constitutes the body of the work, and which relates to palæontology.

In considering this department, the number and variety of objects which offer themselves to the naturalist are so great, that the choice was truly embarrassing. Dr. Buckland has judiciously selected a few of the most striking examples from each of the great classes of organic remains, and when speaking of extinct animals, has explained the method by which the anatomist and physiologist have been able to restore the organization of the entire individual, by reasoning from the evidence afforded by a few bones or other relics preserved in a fossil state. He has described the parts of the living animal or plant most nearly analogous to those which are found buried in the earth, usually illustrating by figures the distinctness and at the same time the resemblance of the recent and extinct species, showing that all are parts of one great scheme, and that the lost species even supply links which are wanting in the existing chain of animal and vegetable creation.

It is impossible to read the account given of the Megatherium, and to contrast it with that drawn up by Cuvier of the same species, without being struck with the increased interest and instruction, and the vast accession of power derived from viewing the whole mechanism of the skeleton in constant relation to the final causes for which the different organs were contrived.

The chapter on saurian and other reptiles has afforded the Professor another beautiful field for exemplifying the infinite variety of mechanical contrivances and combinations of form and structure which the fossil representatives of that class exhibit.

The account also of the Cephalopodous Mollusca, so many thousands of which are scattered through the strata, and which until very recently have presented so obscure a problem to the naturalist, is full of original observation. The history of the animals which formed the Belemnites, of which it appears that nearly one hundred species are now known, and the proofs adduced that they were provided with ink-bags like the cuttle-fish, the description also of the fossil pen-and-ink fish, or Loligo, and other sections of this part of the Treatise, carry our information respecting the family of naked Cephalopods much farther than was ever attempted in any previous work. Nor should I omit to mention the exposition of an ingenious theory for the use of the siphuncle and air-chambers of the Ammonite, which, whether confirmed by future examination or not, becomes in the author's hands the means of conveying to the reader a clear and well-defined notion of the varied forms and complicated structure of these shells, and of awakening a lively desire to understand their singular organization.

I may also recall to your notice the just and striking manner in which certain physical inferences are drawn from the conformation of the eyes of extinct Crustacea, such as the Trilobite. The most delicate parts of these organs are sometimes found petrified in rocks of high antiquity, and it is justly observed, that such optical instruments give information regarding the condition of the ancient sea and ancient atmosphere, and the relations of both these media to light. The fluid in which these marine animals lived at remote periods must have been pure and transparent to allow the passage of light to organs of vision resembling those of living Crustaceans; and this train of reasoning naturally leads us still further, and to more important consequences, when we reflect on the general adoption of the undulatory theory of light, and the connexion between light, heat, electricity, and magnetism.

I have heard it objected, that the zoologist and botanist had already advanced such abundant proofs of design in the construction of living animals, and plants, that the auxiliary evidence of palæontology was useless, and that to appeal to fossils in support of the same views was to add weaker to stronger arguments. In the living animal, it is said, we can study its entire organization, observe its habits, see the manner in which it applies each organ, and so verify with certainty the ends for which any particular member was formed and fashioned. But in the case of the fossil, we have first to infer the greater part of the organization from such parts as alone remain, and then further to infer from analogy the habits and functions discharged, and lastly the former conditions of existence of the creatures so restored. If then we occasionally fall into error when speculating on the use of the organs of living species, how much more easily may we be deceived in regard to the fossil!

In answering this objection, it cannot be denied that the data supplied by palæontology are less complete; but they are nevertheless abundantly sufficient to establish a very close analogy between extinct and recent species, so as to leave no doubt on the mind that the same harmony of parts and beauty of contrivance which we admire in the living creature has equally characterized the organic world at remote periods. If this be granted, it is enough; the geologist can then bring new and original arguments from fossil remains to bear on that part of natural theology which seeks to extend and exalt our conceptions of the intelligence, power, wisdom, and unity of design manifested in the creation.

It can now be shown that the configuration of the earth's surface has been remodelled again and again; mountain chains have been raised or sunk, valleys have been formed, again filled up, and then re-excavated, sea and land have changed places, yet throughout all these revolutions, and the consequent alterations of local and general climate, animal and vegetable life has been sustained. This appears to have been accomplished without violation of those laws now governing the organic creation, by which limits are assigned to the variability of species. There are no grounds for assuming that species had greater powers of accommodating themselves to new circumstances in ancient periods than now. The succession of living beings was continued by the introduction into the earth from time to time of new plants and animals. That each assemblage of new species was admirably adapted for successive states of the globe, may be confidently inferred from the fact of the myriads of fossil remains preserved in strata of all ages. Had it been otherwise, had they been less fitted for each new condition of things as it arose, they would not have increased and multiplied and endured for indefinite periods of time.

Astronomy had been unable to establish the plurality of habitable worlds throughout space, however favorite a subject of conjecture and speculation; but geology, although it cannot prove that other planets are peopled with appropriate races of living beings, has demonstrated the truth of conclusions scarcely less wonderful, the existence on our own planet of many habitable surfaces, or worlds as they have been called, each distinct in time, and peopled with its peculiar races of aquatic and terrestrial beings.

Thus as we increase our knowledge of the inexhaustible variety displayed in living nature, and admire the infinite wisdom and power which it displays, our admiration is multiplied by the reflection that it is only the last of a great series of pre-existing creations of which we cannot estimate the number or limit in past time.

All geologists will agree with Dr. Buckland, that the most perfect unity of plan can be traced in the fossil world throughout all the modifications which it has undergone, and that we can carry back our researches distinctly to times antecedent to the existence of man. We can prove that man had a beginning, and that all the species now contemporary with man, and many others which preceded, had also a beginning; consequently the present state of the organic world has not gone on from all eternity as some philosophers had maintained.

But when conceding the truth of these propositions, I am prepared to contest another doctrine which the Professor advocates, namely, that by the aid of geological monuments we can trace back the history of our terraqueous system to times anterior to the first creation of organic beings. If it was reasonable that Hutton should in his time call in question the validity of such a doctrine, whether founded on the absence of organic remains in strata called primary or in granite, still more are we bound, after the numerous facts brought to light by modern geology, to regard the opinion as more than questionable. I observe with pleasure that Dr. Buckland broadly assumes what I have elsewhere termed the metamorphic theory, having stated in his 6th chapter that beds of mud, sand, and gravel, deposited at the bottom of ancient seas, have been converted by heat and other subterranean causes into gneiss, mica slate, hornblende slate, clay slate, and other crystalline schists. But if this transmutation be assumed, it must also be admitted that the obliteration of the organic remains, if present, would naturally have accompanied so entire a change in mineral structure. The absence, then, of organic fossils in crystalline stratified rocks, of whatever age, affords no presumption in favor of the non-existence of animals and plants at remote periods.

The author, however, in another part of his Treatise contends, that even if the strata called primary once contained organic remains, there is still evidence in the fundamental granite of an antecedent universal state of fusion, and consequently a period when the existence of the organic world, such as it is known to us, was impossible. There was, he says, one universal mass of incandescent elements, forming the entire substance of the primeval globe, wholly incompatible with any condition of life which can be shown to have ever existed on the earth.* Believing as I do in the igneous origin of granite, I would still ask, what proof have we in the earth's crust of a state of total and simultaneous liquefaction either of the granitic or other rocks, commonly called plutonic? All our evidence, on the contrary, tends to show that the formation of granite, like the deposition of the stratified rocks, has been successive, and that different portions of granite have been in a melted state at distinct and often distant periods. One mass was solid, and had been fractured before another body of granitic matter was injected into it, or through it in the form of veins. In short, the universal fluidity of the crystalline foundations of the earth's crust can only be understood in the same sense as the universality of the ancient ocean. All the land has been under water, but not all at one time; so all the subterranean unstratified rocks to which man can obtain access have been melted, but not simultaneously.

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*. Buckland's Bridgewater Treatise, vol. 1. p. 55.

Nor can we affirm that the oldest of the unstratified rocks hitherto discovered is more ancient than the oldest stratified formations known to us; we cannot even decide the relations in point of age of the most ancient granite to the oldest *fossiliferous* beds.

But why, I may ask, should man, to whom the early history of his own species and the rise of nations presents so obscure a problem, feel disappointed if he fail to trace back the animate world to its first origin? Already has the beginning of things receded before our researches to times immeasurably distant. Why then, after wandering back in imagination through a boundless lapse of years, should we expect to find any resting-place for our thoughts, or hope to assign a limit to the periods of past time throughout which it has pleased an omnipotent and eternal Being to manifest his creative power?

But it is not my intention to advert now to these and other points on which I happen to differ from Dr. Buckland. I would rather express the gratification I feel in finding myself in perfect accordance with him on so many subjects. His work is admirably adapted to convey instruction on organic remains, and other departments of geology, both to beginners and to those well versed in the science, and is characterized throughout by a truly philosophical spirit, which betrays no desire to adhere tenaciously to dogmas impugned or refuted by the modern progress of science. On the contrary, the author has abandoned several opinions which he himself had formerly advocated; and although still attached to the theory which teaches the turbulent condition of the planet when the lias and other fossiliferous rocks were formed, and the general insufficiency of existing causes to explain the changes which have occurred on the earth, he yet refers in almost all parts of his book to the ordinary operations of nature to explain a variety of phenomena once supposed to be the result of causes different in kind and degree from those now acting.

I have now, Gentlemen, only to offer you my acknowledgments for the high honor conferred upon me by my election to fill the President's chair for the last two years; and it is a source of great satisfaction to me to feel assured of the continued prosperity and usefulness of the association when I resign my trust into the hands of a successor so distinguished for his zeal, talents, and varied acquirements as Mr. Whewell.

Art. VIII.—*Experiments in Electro-Magnetism*; by Dr. Charles G. Page, of Salem, Mass.

TO PROFESSOR SILLIMAN.

Dear Sir—I notice in the July No. of the Franklin Institute Journal, an announcement of the discovery of the thermo-electric spark by an Italian philosopher, and also the subsequent exhibition of the spark by Prof. Wheatstone to Faraday and others; the date of the discovery is not given. On referring to my notes I find that I obtained the spark in August last, but not the shock. The spark and shock were both obtained Dec. 2d, 1836, and exhibited to a number of friends, and announced in your last No. It appears that the European philosophers have not yet obtained a current of sufficient magnitude to afford a shock by the multiplier, although they use in the experiment a great number of pairs. In my experiment only a single pair is used either of bismuth and iron, bismuth and zinc, or bismuth and antimony, and yet the induced or lateral shock given by the multiplier is very distinct by acupuncture. The particular arrangement of the thermo-electric elements to produce such powerful effects, I do not wish to describe at present, as I hope ere long to announce it as a substitute for galvanic batteries in many experiments.

On the disturbance of Molecular forces by Magnetism.

A short article on this subject appeared in the last No. of this Journal, under the caption *Galvanic Music.* The following experiment, (as witnessed by yourself and others not long since,) affords a striking illustration of the curious fact, that a ringing sound accompanies the disturbance of the magnetic forces of a steel bar, provided that bar is so poised or suspended as to exhibit acoustic vibrations. An electro-magnetic bar four and a half inches in length, making five or six thousand revolutions per minute near the poles of two horse shoe magnets properly suspended, produces such a rapid succession of disturbances, that the sound becomes continuous, and much more audible than in the former experiment, where only a single vibration was produced at a time.

On the application of Electro-Magnetism as a moving power.

Late in the fall of last year, (November,) I commenced the investigation of this subject, not knowing that any thing more had ever been effected than what appeared in an instrument before me at that time, viz. Ritchie's revolving galvanic magnet, which consists of a horizontal bar of soft iron covered with copper wire, the ends of the wire descending into mercury cells. This instrument was the basis of my pursuit. Finding that this bar never attained its maximum velocity, from the occasional union of the battery poles, I soon remedied this defect by a contrivance, wherein the bar moved vertically, and the mercury cells were entirely independent of each other. The instrument thus improved became an interesting and useful piece of apparatus, and is in fact the revolving interruptor described and figured in the last No. of the Journal. The stationary magnets, instead of being single contrary poles, at opposite sides of the circle described by the bar, were multiplied so as to form an entire circle of poles, with the exception of an inch on each side between the opposite poles. The magnets were short bars arranged in the form of a cylinder, somewhat like the staves of a barrel, and the poles not in use were united by armatures of soft iron. The velocity of this model was very great, but I found the scattering and oxidation of the mercury a great inconvenience and soon substituted for it solid conductors. The wires on the bar had their similar ends united by single wires, which were brought down and soldered by cylindrical segments of metal, firmly fixed upon, but insulated from the axis. These segments, representing the ends of the wires covering the revolving bars, were insulated from each other by pieces of horn or ivory. Two wires connected with the poles of the battery pressing against these segments with a spring, furnished sufficient metallic contact to ensure the passage of the galvanic current through the wires from end to end. As the segments revolved, they presented opposite ends of the wires to the fixed battery wires and thus the poles were changed.* But the most important discovery in relation to the application of this power, is the following, viz. the admissibility of oil between the solid conducting surfaces. After the ma-

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* Before the appearance of the April No. of this Journal, in which Davenport's machine was partly described, I addressed a letter to Prof. Silliman, to learn if he was aware of any experiments of the kind hitherto made. His answer was, "the best information you can have on this subject, will be embodied in the coming No. of the Journal." The Journal appeared with a description of Davenport's machine, but the mode of making battery connection and changing poles was reserved, and until within a short time since, I supposed that mercury was the medium. Finding lately that he used dragging wires upon semizones of metal, I have secured the above arrangement to myself by patent.

chine had revolved for a time, I found it necessary to free the revolving segments, (or discs they may be called,) from oxide, even when it was made of silver, gold or platinum. Amalgamating the surfaces, the oxide collected with still greater rapidity. It occurred to me that if the interposition of oil or naphtha would not interrupt the current, the oxidation of the rubbing surfaces might be entirely prevented. On trying oil I was agreeably surprised to find that the current was not only not interrupted when the pressure of the metals was very slight, but that it passed with greater certainty, and enhanced the operation of the machine six fold. It appears that oil more than compensates for its non-conducting property, by keeping the surfaces free from oxide.

This discovery will prove of vast importance in the laboratory, as it will dispense with the use of mercury in many experiments, and prevent the constant necessity of amalgamating and cleaning conductors. Having attained such an advantage in small models, I proceeded to the construction of a large one. The revolving bars are a foot in length and weigh together ten pounds. They are disposed at right angles on the same axis, but revolving in opposite ends of the cylinder of magnets. With steel magnets its power is very great; but with galvanic magnets its power is sufficient to carry a machine for covering copper wire with cotton; and with the addition of more coils of wire, might doubtless be made to turn a large lathe. Now although it is certain that machines of this description may be applied to a considerable extent, yet it is evident that their power is limited. These and all other similar machines must be liable to the objection, that their magnetic forces cannot be made commensurate with their size and weight. This objection I have surmounted, (as far as theory and a small model afford proof,) by the following arrangement. Instead of extending large bar magnets through the whole diameter of the circle, I have horse shoe magnets carried near to the circumference of the circle. They are arranged on arms or radii like the spokes of a wheel, and both poles of each horse shoe are in operation at once. They each change their poles four times in each revolution, and the change is effected as before by revolving segments or discs. From the great success of a small model on this plan, I have commenced and now nearly finished an engine on a grand scale; from which I expect great power. The revolving apparatus weighs nearly a hundred pounds. If its power should be in proportion to that of the small model, it must exceed one horse.

Salem, August 15, 1837.

Art. IX.—*Remarks on the Rocks of New York*; by Prof. C. Dewey.

TO PROFESSOR SILLIMAN.

The opinion seems to be prevailing that the rocks of this section of our country are chiefly *transition*. A great portion had been ranked among the *secondary*. For this there was a natural reason, viz. the horizontal position of the strata, and the general appearance of the rocks so diverse fron those of primitive countries; especially, as the fossils were not understood. As early however as 1829, Prof. Vanuxem stated his conviction that these rocks are transition,* and in Bakewell's Geology, republished in the same year, you remark in the "Outline," p. 55, upon the rocks of Lockport and Niagara, that "there is a strong approximation to the transition character." This is now well ascertained in relation to rocks much below those in their geological relations. Besides the evidence offered in this Journal for last January, by Dr. Hayes, of Buffalo, and in the Geological Report of this State to the Legislature last winter, I propose to present that which has occurred to me. The subject was pressed upon my attention soon after my removal to this city last year, by considering the position of the coal mines in Pennsylvania and Ohio, and the strongly bituminous odor of the rocks in the *calciferous slate* of Eaton, and the appearance of bituminous shale in the strata above this.

The *dip* of the strata towards the south over a great extent of this State and Ohio and the western part of Pennsylvania, would carry the saliferous rock of Eaton and several of his incumbent strata *far beneath* the rocks in Pennsylvania and Ohio, which have the same relative elevation above the sea. As we pass from Lake Ontario, south and west, strata after strata lie upon each other in successive elevations, all having their dip towards the south, and with nearly the same inclination. Along the Genesee river it is one foot in eighty to one hundred feet. If we call it only one in a hundred, in fifty miles, which is less than the distance to the southern boundary of the State, the dip would place the rocks two thousand six hundred and forty feet or half a mile below their relative situation near Lake Ontario.

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* See Am. Jour. Vol. xvi. p. 254. See also Bakewell's Geology, 2d Am. Ed. p. 369.

The surveys for canals and railroads, presented in various reports of the engineers, show us the relative situation of the strata at various places.

	Feet.
Lake Erie is above the level of tide water,	570
Top of Niagara falls below Lake Erie,	66
Water of the canal at Rochester below Lake Erie,	64
Bottom of falls at Niagara, (160 feet,) below Lake Erie,	226
From bottom of falls to Lewiston,	104
Lake Ontario is below Lake Erie,	330
Top of falls at Rochester below water of the canal,	31
do. do. falls of Niagara,	33
Canal at Rochester above Lake Ontario,	266
Summit level of Genesee and Olean Canal is above the canal at Rochester,	950
The hills near it are several hundred feet higher.	
Allegany river at Olean above canal at Rochester,	900
Ohio river at Pittsburgh is below Olean,	650
do. do. above canal at Rochester,	250
do. do. Lake Erie,	186
Coal at Pittsburgh above the Ohio,	329
do. do. Lake Erie,	515
do. do. canal at Rochester,	579
do. do. Lake Ontario,	845
Ohio at Little Beaver river, near west line of Pennsylvania, is above Lake Erie,	75
Coal near Little Beaver above Lake Erie,	412
Elevation of hill above the coal,	80
do. this coal bed above canal at Rochester,	476

Passing from the Catskill range over its graywacke to the *saliferous rock* of Eaton, which shows itself east of Utica and extends westward to Niagara, lying under all the rocks of this extended district, the location requires it to be the *old red sandstone* of European geologists. It contains abundance of *Fucoides Brongniartii,* Harlan, and many other similar vegetable remains. On this sandstone rests a series of slates, limestones, shales, and siliceous strata, which correspond perfectly to the mountain limestone of Europe, as noticed by Dr. Hayes in his communication already referred to. This great stratum of our mountain limestone includes the strata called by Prof. Eaton, ferriferous slate, argillaceous iron ore, ferriferous sandrock, calciferous slate, geodiferous limerock, and cornitiferous limerock.

More than one hundred feet in depth of the old red sandstone, and another hundred feet of the first four strata just mentioned, are seen at one view at the lower falls of the Genesee. In the calciferous slate which forms the precipitous banks of the river at and above the lower falls, and which is strongly bituminous, trilobites are found in abundance. *Asaphus caudatus*, as figured in Buckland's Geology and Mineralogy, abounds, and is associated with the Orthoceratite and Productus, and occasionally Spirifer. Another trilobite is less abundant, and a third species still more rare, *Calymene Blumenbachii?* It has been found in the thick layer of the fragile argillaceous slate which lies *above* the ferriferous sandrock, and is precisely the same rock as the ferriferous slate which lies under the same stratum and which in truth occurs all through the calciferous slate in thin layers. In the rocks still lower in the geological series the species of tribolite abound. The trilobites of Trenton falls and of the neighborhood of Utica, had placed those rocks in the transition series; but it was supposed they were of very limited extent. It needed only the evidence, now arising from the existence of *trilobites alone*, to prove that the rocks immediately above the sandstone belong to the same formation with those at Trenton falls, and that the rocks of this section belong to the transition series. The position and fossils place the rocks far below the secondary, and render utterly improbable the existence of coal in them or under them. They rank with the mountain limestone of Europe and rest on the old red sandstone. Several names of the rocks given by Prof. Eaton to this mountain limestone are very appropriate, and they make an intelligible reference to different portions of the strata very easy and satisfactory. Still, they seem to form only different parts of the great formation of mountain limestone. Its whole thickness here and southward in the state, will be more than a thousand feet.

Rochester, August, 1837.

NOTE.—The remains of the elephant in the museum of Mr. Bishop, noticed in the last number of this Journal, belong to one species of the mastodon. The teeth of the elephant were from some place, it is said, in Ohio. Those of the mastodon were found with the tusk in Perinton, as described. C. D.

Art. X.—*Queries proposed by the Geologists of the new Survey of the State of New York.*[*]

Rocks.

1. Have *ledges* of rock been observed in your vicinity?

2. Are the ledges on the sides, or on the summits of hills; on the shore, or in valleys?

3. Is the direction of the ledges parallel to that of the hills, or what is the direction of each by compass?

4. Are the rocks divided into regular layers?

5. Towards what point of the compass do these layers pitch with the greatest declivity?

6. Are there veins of other rocks traversing those before mentioned?

7. In what direction do these veins cut through the rock, and are they perpendicular or inclined?

8. Have any ores been found, either diffused through the mass of rock, or in separate beds or veins?

9. Have any useful, or curious, or rare minerals been found in the rocks or veins?

10. What names are commonly used to designate the rocks, ores, minerals, &c. referred to?

11. Have they been applied to any useful purposes?

12. Where ledges of rocks have been recently uncovered by excavations, are the surfaces smooth, as if by the action of running water, or with pot-holes, such as are seen at many water falls?

13. Do any of these surfaces shew grooves and scratches, as if hard masses had been dragged over them?

14. Do the rocks recently uncovered shew traces of the shells of barnacles, or other marine remains attached to them in sheltered situations, and much above the level of the sea?

15. Are shells or petrifactions of any kind, or the remains of plants, found in any of the rocks, and in what kinds of rocks do they occur?

16. Are slate, limestone, sandstone, granite, gneiss, &c. found in your vicinity?

17. Where rocks of different kinds come in contact, is there any change in their characters near their junction?

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[*] Received from W. W. Mather of the survey, and being of general interest we insert them here.—*Editor.*

18. Do the rocks shew distinct lines of demarkation, or do they gradually blend into each other?

19. At the junction of trapean and granitic rocks with others, are there any evidences of former high temperature, such as sublimation of sulphur into cavities, cokeing of coal, apparent fusion of the rock, a vesicular texture, or other appearances which are familiar to the mind, where the bodies have been heated?

20. Where masses of granitic or trapean rocks occur *in situ*, can any connection be traced between these and dykes or veins of similar materials which traverse the adjacent rocks?

Sands.

1. Are there beds of fine white sand, which contain no black, or red, or yellow grains?

2. Has it ever been used for making glass, or for other purposes?

3. Are there beds of red or black sand washed upon the beach?

4. Are these sands abundant enough for purposes of commerce?

5. Have they ever been used as iron ores, or as a substitute for emery, or for blotting sand?

6. Is the general surface of the country sand, clay or loam?

7. Do these substances form alternating regular layers?

8. Does the sand on the surface of the country drift by the wind?

9. Have any farms been thus materially injured?

10. Have buildings, trees, hedges, fences, or walls been covered from this cause; or marshes or ponds made dry land? Do the sands progress in any particular direction, and at what rate per annum?

11. Is the sand in any locality hardened into a sandstone?

12. Is sand washed along shore by currents, and deposited in new situations?

13. Are any islands, sand-bars, spits, shoals, or beaches, known to have been thus formed?

14. Have islands been connected with each other, or with the main land, by bars, spits, or beaches?

15. Have islands or coasts been washed away entirely, or in part, by the action of the sea?

16. Where cliffs have been undermined, and have tumbled down, what kinds of earth, or rock, were exposed?

17. Were they arranged in layers?

18. Were bones, shells, bits of wood, or lignite imbedded in them?

Clays.

1. Are any beds of clay known in the vicinity?

2. Are the beds extensive or of small magnitude?

3. At what depth do they lie below the surface?

4. What is the thickness of the bed or beds?

5. What materials were observed in digging down to them?

6. Are the clays in thin layers which easily separate?

7. Do the beds of clay alternate with beds of sand and gravel?

8. Are the layers of the beds of clay, gravel, or sand, inclined, or are they level or undulating?

9. What is the color of the clay?

10. Is it mixed with sand or is it free of grit?

11. When mixed with water, does it form a tough and plastic mass, or does it crumble to a pap?

12. When heated red hot, does it become red, brown, or white?

13. To what useful purposes has it been applied?

14. What quantities are annually exported, and for what purposes?

15. Has it been tried as a manure on sandy soils?

16. Do balls, or flat rounded masses of a hard earthy mineral, occur in the clay?

17. Are they arranged in layers parallel to the layers of clay?

18. Are they of the same materials as the clay?

Water, Springs, &c.

1. At what depth is water obtained?

2. What strata are passed through before reaching it?

3. Does clay, loam or rock, occur at the level of the springs?

4. Is the water "hard" or "soft," as these terms are usually employed when speaking of water?

5. Did the water percolate gradually into the well when first dug, or did it come in a strong stream?

6. Have shells, bones, pieces of blackened or common wood, beds of marl, or of clay, been observed in digging wells or cellars, or by the caving down of cliffs or banks on the shore, or by the side of streams?

7. Have mineral springs been discovered?

8. What is their taste? sulphurous, inky, pungent, or saline?

9. Is there any sensible odor to the water? What is it like?

10. Is the water sparkling like bottled beer; and does air bubble up from the fountain?

11. Is there a reddish or yellowish deposit where the waters flow off, or in the adjacent meadows, or ponds, or is there a similar oily scum on the water?

12. Do sticks, mosses, leaves, &c. become incrusted with a hard stony coat, or is there a gray or yellowish rock forming near the spring, by a deposit from its water?

13. Has the water been used in the cure of any diseases?

14. Is the spring copious?

15. Do large springs burst from the earth?

16. What is the temperature of springs?

Salt Marshes.

1. Have the salt marshes in your neighborhood remained unchanged during the observation of the old inhabitants?

2. If they have risen in level, to what cause do you attribute it? to animal or vegetable decomposition, or to both, to drift sand, mineral springs, &c., wash of the sea, wash of the adjacent hills, or all these?

3. If they have sunk below their former level, did it happen gradually, or suddenly?

4. If the latter, was it at the time of any extraordinary natural phenomenon?

5. Of what materials are your meadows composed?

6. Are they covered with moss and cranberries?

7. Can they be made to tremble by walking or jumping on them?

8. Have they changed in the amount of surface that can be mowed, within the period of a life?

9. Are there any evidences or traditions that they were once larger or smaller than they are at present?

Submarine Forests.

1. Have trees, stumps, or logs been seen standing in the water on any part of the coast of Long Island, or of the adjacent coasts or islands?

2. Where have they been seen, and in what depth of water?

3. Is the time of the subsidence of this land known?

4. To what cause do you attribute it?

5. Is there any tradition concerning it?

6. Is the wood in its natural state, or is it more like charcoal in its appearance?

Subterranean Forests.

1. In digging wells, or other excavations, or by the caving down of banks and cliffs of earth, have any traces of trees, wood, bark, leaves, nuts or seeds been discovered buried deep in the earth, or at a greater depth than we would expect to find them from the effect of present causes?

2. Were these remains in their natural state, or were they converted to stone, or to a black substance like charcoal?

3. If the latter, has the substance been used as fuel?

4. At what depth does it lie? and in what earth? (sand or clay?)

5. What strata were observed above and below?

6. Do the trees stand erect?

7. Do they lie all in one direction?

8. Do you suppose drifting sands, washing by water, or other causes have buried them?

9. What is the situation of this lignite with regard to the sea, or to water courses, and its relative height or depth above or below them?

10. Have shells or bones been found in the layer containing the lignite, or in the adjacent strata?

11. What is the color of the adjacent clay, sand or gravel?

12. Have masses of a heavy yellow metallic stone (pyrites) been found in the adjacent clay? and has it been applied to use?

Peat Bogs and Shell Marl.

1. Are there inland meadows or swamps in your vicinity that tremble when one walks over them?

2. Are they covered by moss, and cranberry vines?

3. To what depth can a pole be thrust down?

4. How many are there, and of what extent in your vicinity?

5. Does the peat, or black tremulous mud, rest on sand, gravel, rock, or a white clayey marl containing small shells?

6. Has the peat been used for fuel, or for burning lime or bricks?

7. Has the peat, or shell marl, been used as a manure?

Bog Iron Ore.

1. Are there ponds or marshes in the vicinity, in the bottom of which is a soft spongy, yellowish brown stone, or gravel?

2. Does it originate from mineral springs, or from stagnant waters?

3. Has it been used as an iron ore?

Marshes.

1. Have the marshes on the borders of lakes, on the banks of streams, or on the flat table lands, in your vicinity, changed materially within the period of history, or within the remembrance of old inhabitants?

2. Have they become more wet, and risen so as to cover land before dry?

3. Have they sunk in level, and from what cause?

4. Have they become more dry, and from what cause?

5. Have they changed in the natural growth of the soil?

Drainage of Lakes.

1. Are there any evidences of the lakes in your vicinity having once occupied a higher level than they do at present?

2. Does this evidence consist in elevated beaches, or the cutting down of their outlets, or both these combined?

3. Are there valleys which seem to have been once lakes, and what evidence is there on this point?

4. Are there regular stratified deposits of clay, sand, gravel, &c. in the valleys?

5. Are organized remains of plants or animals found in them?

6. In the gorges at the outlets of lakes, or along the courses of the streams, which flow from them, are there marks to show the wearing action of water much above its present level.

7. Are there deep defiles through the country through which the water flows or seems to have once flowed?

8. What is the nature of the strata of those defiles, and generally, of the country at any of the particular localities to which you may have referred?

Rivers.

1. Are the rivers and streams in your vicinity, deepening their channels, or raising their beds by the deposit of alluvial matter?

2. Do you know of instances of lateral streams bringing in such quantities of alluvial matter, and of so coarse a texture, that the larger stream is unable to sweep it away, and causes the formation of lakes in the valleys above?

3. Are rivers or smaller streams lost by sinking in the ground?

Rolled Masses, Pebbles, and Erratic Blocks.

1. Are any large rounded or irregular masses of rock found in your neighborhood?

2. Do they occur mingled with gravel and pebbles, or are they isolated on the surface, or imbedded in the earth?

3. Do they crumble away by the effects of the weather?

4. Are they smooth, or nearly so, like pebbles?

5. Are there scratches on them in one or more directions?

6. Are there ridges on them in one direction only from the harder points of the stone, and parallel to the scratches?

7. Are these rounded masses all of one kind of rock?

8. What rock or rocks constitute these masses and pebbles?

9. Are they similar to ledges of rock known to you, either in the vicinity or elsewhere?

10. Are barnacles or other shells, or the remains of marine animals observed on them, where they are at a distance from the sea, or buried in the earth?

11. Has ice been known to move masses of rock in ponds, streams, bays, or inlets?

Elevation of Land.

1. Are there beds of rock containing remains of animals or plants, whose proper habitat is the ocean?

2. Are the rocks horizontal or inclined?

3. Are they bent, contorted, or are they dislocated?

4. What is the direction of the line of bearing of the strata?

5. Is there any evidence that the rocky strata have been elevated at one, or at several epochs? If at one epoch, all the strata are conformable up to the time of its occurrence, unless in the rare case of elevation without derangement of the dip. If at several, the strata, formed subsequent to each of these epochs, are successively unconformable to those below, with the same exception as above.

6. Are the axes of elevation parallel, or do they intersect, and what are their directions?

7. The occurrence of anticlinal and synclinal lines, and their directions, should be particularly noted.

Agriculture, Manures, &c.

1. What manures are employed on the soil?

2. Has a rotation of manures been tried?

3. What rotation of crops is employed on the light, and what on the heavy soils?

4. Have changes of rotations of crops been tried, and with what success?

5. How are your manures prepared?

6. Does lime, or ashes, or marl, or gypsum, or barilla, enter into the composition of the compost heap?

7. Has salt, or nitre, or copperas been tried in small quantity on the land as a manure?

8. Has limestone, or any other rock been ground and used as a manure?

9. Do fish cause the production of as large a crop, when spread upon the soil, as when ploughed in fresh?

10. Has peat been rotted and tried as a manure?

11. Have harbor mud and pond-hole mud been tried?

12. Have clay soils been dressed with sand, sand soils with clay, and marshes with gravel or sand?

13. Are banks of shells known, except such as have been left by the Indians, and which are either superficial, or buried by a small depth of turf, drift sand, or earth washed over them, where the water flows?

Are there caves, land-slips, sink-holes, (formed by the sinking down of small tracts,) rocking stones, natural ice-houses, or curious or interesting natural phenomena of any kind that have come under your observation, not embraced in the preceding queries?

Suggestions for collecting Geological Specimens, and observing Geological Phenomena.

1. Collect specimens of all those rocks, earths, sands, clays, peats, marls and lignites observed, and note the relative quantities, whether abundant or rare.

2. If any of these materials be applied to useful purposes, note their particular applications, the places where used, the amount of industry and capital employed, and the articles produced.

3. If they be not used, note whether in your opinion any one or all may be usefully employed, and for what; and what facilities the adjacent country may present for manufacture or transport, or from its contiguity to a market.

4. Note the order of superposition of the different beds of rock, earth, sand, clay, &c. with regard to each other; the amount and di-

rection of the dip; whether dislocations or faults, dykes, veins, &c. traverse the strata, and the direction and inclination of these dislocations, veins, dykes, &c. Sketches should generally be made to illustrate the thickness and relative position of strata, particularly if the strata be contorted.

5. Note if any traces of organic existence be observable in any of the materials mentioned, whether animal or vegetable, either as impressions, casts, or petrifactions; whether imbedded or loose in these materials.

6. The excavations in mining, quarrying, cutting canals, railroads, &c. offer particular facilities for observing the phenomena of stratification, of the superposition of rocks, &c.

7. In boring for coal, salt springs, &c. it is hoped that specimens of the rock, clay and sand, of every foot in depth passed through will be preserved, and accurate minutes made in writing on the spot.

8. In deep wells, mines and salt springs, the temperature of the water should be measured as it issues from the strata.

9. The temperature of copious springs should be measured, noting if it be different at different seasons of year.

10. In mines, is there a local variation of the compass, and are there evidences of the passage of electrical currents?

11. What is the mean temperature of the bottom of the mine? and of the rocks at the ends of the levels, at such a depth as to be beyond the influence of the heat of the air of the mine?

12. Specimens to illustrate the various kinds of minerals, rocks, clays, marls, peats, &c., should generally be about two by three, or three by four inches, and one to two inches thick, of a rectangular form, and free from hammer marks and weathering.

13. Fossils, or rock specimens containing fossils, must be taken of such a size as may be necessary to illustrate to the best advantage; still, where fossils are imbedded in stone, much taste may be displayed in getting them out with a good shape and free from hammer marks.

14. The occurrence of bones, tusks, teeth, shells, &c. where wells, cellars, canals, roads, &c. have caused excavations to be made, should be particularly noted.

15. Every specimen from the same *stratum* at any *one locality* should be marked with a similar mark, and each specimen to correspond in its mark with that of the stratum from which it was taken, on the sketch or section.

16. Each specimen should be wrapped securely in a separate paper, and packed tightly in a box, so that it may not be rubbed and injured by transportation from one part of the country to another.

17. It is important that rock specimens and fossil remains should be taken from ledges of rocks in their natural position and not from loose masses.

18. Soils should be taken from a depth of about 8 inches below the surface.

19. The name of the county, township, and the estate, should be distinctly marked on a small label, which should be enclosed in the wrapper of the specimen.

W. W. Mather, } *Committee in behalf of*
T. A. Conrad, } *the board of Geologists.*

Art. XI.—*Notice of the Meteors of the* 9*th and* 10*th of August,* 1837, *and also of Nov.* 12*th and* 13*th,* 1832; by George C. Schaeffer, of New York.

TO THE EDITOR.

Having had the good fortune to witness another "meteoric display," and one which, as far as I can ascertain, has not been generally noticed, I furnish you with the result of my observations, which if not rendered valueless by some other and better notes on the same subject, by some of our citizens, are entirely at your service.

Since November last, when I observed the annual appearance of the 12th and 13th, (a short and hastily written notice of which I made for one of our papers, and which was copied into your Journal,) I have constantly watched the meteors of nightly occurrence, with reference to their direction and number. At the expiration of the six months when it was thought that a return might be expected, particular attention was paid, but few or none were seen; the nights, however, were cloudy, and unfavorable for observation.

For two or three weeks previous to the 9th of August, a large number was seen, chiefly radiating from some point in a line from Vega, to the point mentioned below.

About 8 o'clock on the evening of the 9th, my attention was directed to several meteors, which, notwithstanding the bright moonlight, were very conspicuous. Following up the usual observations upon direction, it was soon found that there was a common center of radiation.

It is to be remarked, however, that comparatively few were seen near this point, by far the greater number averaging a distance of 90° from it. On this account, I found it more difficult to designate the radiating point, than in November last, when I determined its place with considerable accuracy. On this occasion, (August 9th,) as near as could be ascertained, the center of radiation was not far from 55° R. A., 60° N. D., or near a point of a line from β to α Urs. Min. produced rather more than the distance between the two stars.

These meteors in every respect, resembled those of November last, a large number having trains of some length and duration, and hardly less brilliant than on that occasion.

From 8 until near 3 o'clock, between two and three hundred were seen. During the last hour the number seemed to diminish, and not having taken any precaution to ensure wakefulness, we were obliged to yield to the solicitations of Morpheus.

The night was a favorable one for observation, and a curious coincidence is to be remarked in the fact that the same sort of lightning was visible in the northeast, as in November last. A shower had passed over us in the afternoon, but as this had not been the case on the former occasion, I am inclined to suspect some connexion between the appearances. There was a close resemblance to what is commonly called heat-lightning, though this appeared farther from the horizon.

In the early part of the evening, the attention of a numerous party was directed to the heavens, and I found that when each observer selected a separate portion, the number noticed was greatly increased: from this I judge that a large number escaped notice.

In the various notices of meteors in your Journal, I recollect but a slight mention of their appearance in 1832.

I was not aware that I had seen them myself, until the latter end of the year 1834, when, describing to a friend a beautiful display of meteors that I had witnessed off Pernambuco, in a voyage home from Buenos Ayres, the resemblance to the meteors of 1833, (as described to me,) for the first time struck my attention. I turned to my journal, and found to my surprise and delight that the minute of their appearance was made on the morning of November 13th, as being viewed during the previous night.

The notice is to the following effect: that numerous meteors of exceeding brightness and beauty were seen, the least of them being more brilliant than Jupiter, then not far from opposition. Many of them had trails, described by the men as similar to a comet, and one was said by them to have remained five or six minutes, though this doubtless was an exaggeration. They also were described by them as having "split off from each other," evidently referring to a radiation from some point. As I remained on deck but a part of the night, I did not see some of the most brilliant meteors as described to me by the men.

Meteors were seen the night before, and as the extreme brilliancy on this occasion induced us to refer them to the atmosphere immediately above us, they were carelessly ascribed to the unusual heat; the minute was made and forgotten until more than two years after.

At the time we were in sight of Pernambuco light, the night was one of the most splendid that I have ever seen in any latitude or under any circumstances.

I very much regret that I have no data for the point of radiation, but as far as it goes, the testimony is good, the note having been made long before any notion was entertained of meteors being other than random fires of unknown origin.

ART. XII.—*Questions relative to Mineral Veins, submitted to Practical Miners;* by ROBERT WERE FOX,* England.

1. Name of the mine, as well as of the parish or district in which it is situated.

2. Number of metallic veins or lodes, and the description of ore which each contains.

3. Average *size, direction by compass,* and *underlie* of each lode, and whether very variable or not in these respects; and do the lodes generally increase or diminish in size in descending into the earth?

4. Nature of the rocks or country traversed by each lode, whether *granite, killas, elvan,* &c., or all of them; and the bearings of the different rocks with respect to each other.

5. If any elvan courses, (porphyritic dykes;) their appearance, hardness, sizes, directions, and underlie.

6. In which of the rocks have the respective lodes been found most productive of ore, and has there been any difference in this respect, between those of copper and tin, or of any other metal?

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* Received through Dr. J. H. GRISCOM, of New York.—The eminent service rendered by Mr. Fox to the cause of science, especially in relation to the electricity of mineral veins, entitle his queries to insertion in this place.—*Editor.*

7. If copper lodes; do they consist of yellow or gray ore, or of any other variety, and how are the varieties of the ore situated with respect to each other in the lodes?

8. If copper and tin occur in the same lodes, are those metals in different parts of them, or if near together, are they at, or near the opposite walls of the lodes, or are they intimately mixed?

9. If near the opposite walls of underlying lodes, which of these metals is the nearer to the upper or hanging walls, and which to the lower or foot walls;—are these ores separated from each other by "*spar*" (quartz,) or other substances; and do the hanging and foot walls differ much in hardness?

10. If other metals exist in the lodes, under what circumstances do they occur; and what minerals have a tendency to crystallize, and how are the crystallized masses situated with respect to the contiguous ores?

11. Was there "*gossan*" or other substance observed resting upon, or above the copper ore in the lodes, or if *strictly tin lodes*, were they found to be without gossan?

12. Are the walls or "*capels*" of the tin lodes harder than those of the copper lodes, and if in the case of a copper lode, one wall is harder than the other, is it the nearer one to the copper ore, or that which is the further from it?

13. Are the lodes, generally speaking, most productive of ore on the side of the hanging, or of the foot walls?

14. Is the rock or country immediately contiguous to the walls of any of the lodes, usually softer or harder than at a distance from them; is there any difference in this respect between tin lodes, and lodes of copper, &c.; and is the hardness or softness of the lodes, in any *direct* ratio or *inverse* ratio, to the hardness or softness of the rock or country contiguous to the walls.

15. Are not the lodes often contracted into small veins or branches, and have any of these been found to open again into large lodes containing ore? In such cases, do not the opposite small veins or branches sometimes overlap each other, or become "*spliced*," as I believe it is termed?

16. Do the lodes materially vary in size in traversing different rocks, and in which rocks are they the largest? Moreover, in passing from one rock into another, from killas, to elvan or granite, for instance, do they suffer any interruption, or break in their course, and if so, how much, and in what direction?

17. Are there any marks in the walls of a given lode, showing that one of its walls is at a lower level than the other, and, if so, to what extent; and is it not usually the hanging wall which is so circumstanced?

18. Are all or any of the walls, smooth and well defined, or are they imperceptible or indistinctly marked? In either case, are the lodes more or less hard than the ground in which they occur?

19. Are the hanging or foot walls most indistinct, and which of them are the hardest?

20. When the tin lodes meet other lodes, are they intersected by them, and if the intersections take place in their underlie, are they thrown up by them, and how much?—The same question may be asked as it respects other lodes.

21. Are there smaller veins *having distinct walls or divisions* included between the walls of the lodes, that is, are the lodes "*comby*" near the surface, or at a greater depth, and are such small included veins parallel, or oblique, as it respects the walls of the lodes, and of what do the former consist?

22. Are there any veins of clay, or veins, or portions of the containing rock, or country, in the lodes, and are they respectively near the hanging or the foot walls?

23. Have any masses of rock been found in the lodes, termed "*horses*" by the miners, and did they appear to be completely separated by the branches of any given lode from contact with the outer walls or country?

24. What circumstances or appearances in the lodes are considered the most favorable indications of any given ore, and what the least so?

25. Is not an increase in the underlie of lodes usually less favorable for ore than when they become more vertical, and are they not generally more contracted in size, and more filled with mechanical deposits when their underlie is considerably increased?

26. If any of the lodes have crossed or intersected other lodes, has it occurred horizontally, or in their underlie, and at what angles; and have they been found more productive of ore at the intersections, or less so?

27. At what depth below the surface have the different lodes been found most productive of their respective ores; and have many cavities, or "*voughs*" been observed in them, and at what depths?

28. Have the arseniates of copper, iron, or lead, or much fluor spar, occurred in any of the lodes; and how were such substances situated in relation to the ores?

29. Is the "*spar*," or quartz immediately contiguous to copper ore, often more porous or friable, (locally termed "*honey comb* or *sugary spar*,") than that which accompanies tin ore, and even more so, than the spar which is at a distance from the copper ore in the same lode?

30. Are there any *cross courses* or *flucans* intersecting any of the lodes, and what are the directions by *compass*, underlie, and average sizes of the former; and are they larger or smaller at the upper than at the lower levels?

31. Are the cross courses "*comby*," or subdivided into smaller veins of clay and quartz, or other earthy matter?

32. How far do the cross courses partake of the nature of the country through which they pass?

33. Do they dislocate or heave the lodes and *elvan* courses, and how much each of them; stating the underlie of the two last, at or near the places of intersection; and are the heaves greater or less at the upper than at the lower levels?

34. Are there any branches, small veins, or "*leaders*" of ore in any of the cross courses between the dislocated extremities of the lodes, or only detached stones of ore; and are the ores in the cross courses the same, or different in their nature or appearance from those in the lodes?

35. Are the lodes more productive of ore near the cross courses, and on both sides, or only on one side of a given cross course, and on which side?

36. Are there any branch veins of ore nearly at right angles to the bearings of the lodes;—of what ores do such rectangular veins consist;—how far have they been seen to extend; what is their underlie;—and are they near the hanging walls of any cross courses?

37. Are there any beds, or "*floors*" of tin, copper, or other metal, and under what circumstances do they occur?

38. Have they walls like lodes, or are they interposed between the beds or laminæ of the rocks?

39. Are they connected with other veins, or quite distinct from them; in what rocks or country are they most prevalent;—and have any of the ores been observed to occur disseminated, or diffused in the rocks, not as veins, but at a distance from lodes or beds of ore?

40. What are the directions of the joints, heads, or natural divisions of the granite, killas, elvan, or other rocks, and do such joints agree, or not, with the general directions of the lodes and cross courses?

R. W. Fox, takes the liberty to submit the accompanying questions to practical miners, hoping that they will kindly reply to them, or to some of them, and add such general observations on the subject of lodes as may appear to be worthy of notice. He hopes that it will not be inconvenient to them to furnish him with the desired information without much delay; it will be quite sufficient merely to refer to the numbers marked against each question.

In any cases in which plans and sections of lodes and cross courses have been made, rough sketches of them will be much valued.

Art. XIII.—*Descriptions of two species of Trilobites, belonging to the genus* Paradoxides; by Mr. James Hall, Corresponding Member of the Yale Nat. Hist. Society.

Read before the Yale Nat. Hist. Society, March 21, 1837.

The following remarks and the accompanying figures are offered to this Society as illustrations of two species of fossil trilobites, which hitherto have been imperfectly and in many respects incorrectly described. The buckler of these species was first observed by Prof. Eaton, and described as the abdomen and tail of an unknown trilobite, which he named in honor of the distinguished Brongniart, *Brongniartia Carcinoidea.* The buckler is often found in great numbers, and almost invariably separated from the abdomen. This circumstance and the peculiar appearance of the fossil, led Prof. Eaton to the above conclusion respecting its nature, which, I believe, was sanctioned by Brongniart. Similar imperfect specimens of the two species were afterwards described by Prof. Green, (with the same views as to the nature of the fossil,) under the new designation *Triarthrus Beckii.* More recently Dr. Harlan has corrected the principal error of preceding authors, (that of considering the buckler as the abdomen and tail,) and has described the specimens as constituting two species of the genus *Paradoxides.* About two years since, while engaged in investigating specimens of unusual perfection from several localities, I observed some inaccuracies and omissions in the last author, arising probably from the imperfection of his specimens, which appear to be of sufficient importance to require new descriptions, generic as well as specific.

Fig. 1.

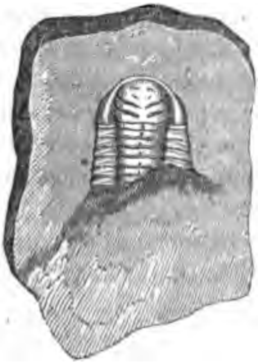
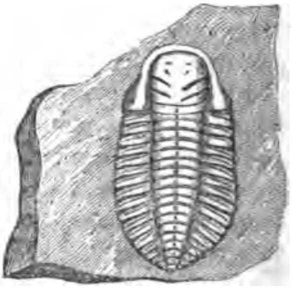


Fig. 2.



From the accompanying figures of these species, it is obvious that they do not strictly belong to the genus Paradoxides, as established by Brongniart; for they are destitute of what this author gives as the most essential characteristic, viz. the extension of the arches of each of the lateral abdominal lobes, beyond the membrane above. This character, however, is scarcely discernible in the P. gibbosus; and as these specimens have a strong resemblance in other respects to the Paradoxides, I concur with Harlan in referring them to this genus. This is an additional instance of the transitions among the genera of trilobites, which interfere with the institution of perfect generic distinctions.

Dr. Harlan observing the incongruities, modified the generic description as follows:*

"Buckler destitute of oculiform tubercles; anterior border semicircular; middle lobe marked with transverse furrows or bands. Abdomen composed of transverse bands or articulations continuous with those of the lateral lobes."

This generic description is evidently faulty. The anterior border in the several species of Paradoxides is seldom *semicircular*, though generally curved and forming the segment of a circle; the transverse furrows, instead of extending across the middle lobe, as might be inferred from the description, are in general interrupted; finally the character with respect to the abdomen is not sufficiently characteristic. I therefore propose the following, as a statement of the essential characters of the genus:

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* It should be remarked that the most perfect specimen examined by Dr. H. presented but four abdominal articulations.

Clypeus antice curvatus: lobis lateralibus antice conniventibus: lobo medio sulcis transversis tribus; sulcis sæpius medio interruptis.

Abdomen lobis tribus bene declaratis; articulis duodecim vel pluribus.

In addition to the above characters of the genus I would state the following, as possessed in common by the two species under consideration.

The *buckler* is much broader than long, with the margin curved anteriorly and truncated posteriorly. The lateral lobes form a narrow border in front of the middle lobe and are expanded behind, and marked with a single transverse furrow, near their posterior margin. The posterior sulcus of the middle lobe is continuous and parallel to the posterior margin of the same; the two preceding sulci, curve slightly backward and are interrupted near the medial line. In front of the sulci, there are two distant slightly oblong depressions, directed obliquely outward and forward, which evidently mark the situation of the eyes. Nearly in front of each of the ocular depressions, there is observed on the fresh specimen, a short transverse line scarcely elevated; with respect to their nature I can only conjecture, that they were occasioned by antennæ lying directly below them, and this appears probable, from the position of these organs in some of the recent Entomostraca most analogous to this genus of trilobites, as for instance the species of the genus Argulus.* A small rounded protuberance occupies the centre of the posterior border of the medial lobe of the buckler.

The *abdomen* is not distinct from the *post-abdomen;* in all there are nineteen articulations, with a small rounded expansion beyond the posterior one. The middle lobe presents a longitudinal row of small spines, one on the centre of each articulation. Near its base it is wider than either of the lateral lobes; from the base it gradually tapers with a slight curve, to the extremity. The lateral lobes increase somewhat in width from their base and attain a maximum width about one third the length of the abdomen from the posterior extremity, where each about equals the corresponding width of the middle lobe; from this point it gradually diminishes to the tail. The following characters distinguish the species.

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* See a figure of an American species of this genus, A. Catostomi, in Vol. xxxi. of this Journal.

Paradoxides Beckii. (Fig. 1.)

Buckler bounded in front and laterally, by a nearly uniform curve scarcely exceeding a semicircle, distinctly convex: lateral lobes cuneiform, broader posteriorly, gradually narrowing from behind forward, and passing into the narrow border which bounds the middle lobe anteriorly; greatest width of each lateral lobe, about one half that of the middle lobe; width of each opposite the centre of the middle lobe, more than two thirds its greatest width: medial lobe somewhat broader than long, rounded posteriorly, convex; sulci deep and well defined, with the intermediate portions arched.

The buckler of this species occurs abundantly in graywacke slate at the Cold Spring on the Erie Canal, eight miles east of Little Falls. This slate lies upon the lower transition limestone, of that part of the state. A small slab from this locality, scarce a foot long and two and a half inches wide, in the cabinet of this society, contains the remains and impressions of near forty specimens of the buckler. I have never met with a perfect abdomen in the Cold Spring slate, though specimens exhibiting a few articulations are common. I have restored the original specific name of this species given it by Green, partially on account of its priority, but more especially because of the inappropriateness of the specific name *Triarthrus* (three-jointed) applied by Harlan. This term, as employed to designate the genus by Green, who supposed that the buckler was the abdomen and tail, and three-jointed, was sufficiently appropriate. But with the present light on the subject, the buckler is very incorrectly described as "triarthritic;" and moreover the existence of the sulci is a generic character.

Paradoxides Eatoni. (Fig. 2.)

Buckler convexly curved on the front margin, with a concave curvature laterally; nearly flat: lateral lobes broader posteriorly, greatest width about one-half the breadth of the middle lobe; abruptly diminishing in breadth and much less than half their greatest breadth opposite the centre of the middle lobe: middle lobe somewhat longer than broad, nearly flat; sulci distinct, with the intermediate portions scarcely convex.

This species is abundant in the graywacke slate in Turin, Utica, Fort Plain, and elsewhere in the state of New York. As Dr. Harlan's name, P. *arcuatus*, is not applicable to this species, I have taken the liberty of substituting the above, in honor of Prof. Eaton.

ART. XIV.—*On the Aurora Borealis of July* 1, 1837.

1. *Observations made at Rochester*, by Prof. C. DEWEY.

ON the evening of July 1st, the Aurora Borealis was very splendid; indeed it far exceeded the splendor of that of the 25th of January last, as that appeared in this part of the state. The day had been pleasant and warm. About two P. M. the temperature was 86°, and a shower was collecting rapidly in the northwest, which in the next hour and a half had been blown over us and dissipated with very little rain. The temperature changed, and the sun shone forth in all his glory. The remainder of the afternoon was delightful. The evening was cool, the temperature being about 58°. Soon as the twilight had ceased, the aurora was seen in short *flocculent*, cloudlike forms all across the northern sky. Soon it extended quite round to the east and west points, at both of which broad and bright arches arose and extended more than half way to the zenith, while a multitude of streamers rose all round the northern sky towards the same point. About half after nine the broad belt of brilliant white aurora, rising from both sides of the east point, shot towards the zenith, near which it was met by a corresponding but less brilliant zone of light from the west. The general appearance continued very brilliant till ten minutes after ten, when the point a little south and east of the zenith, and towards which all the streams and pillars were directed, became a bright rose red, and soon sent off brilliant coruscations in every direction but the south, with distinct flashes of white light much resembling that which is commonly called *heat lightning*. This soon ceased, and the white aurora again appeared as before. Near half after ten, a dark brown aurora rose in the N. W. and extended upwards; soon after appeared on all sides the rose red or deep crimson, rising to the vertex near the star ζ in the constellation Hercules, nearly in a right line between Alpheus in the Northern Crown and Lyra. The whole expanse except the south was most splendid. Soon the flashing from all sides towards the vertex mentioned, was renewed with great power. Great and constant changes in the color were occurring. The white beams and streams intermingled with the red, added to the splendor of the scene; at length the brilliant flashing and waving of the aurora ceased. The vertex became clear of it, except as it flashed up in long and broad waves, and showed itself in serpentine forms for an instant and then disappeared. Soon however the whole scene was repeated. The vertex retained its place, as the constellations moved westward, and was now near μ in Hercules, and all the splendid light, beams, pillars, arrows, waving and flashing, were, if possible, more splendid than before. This was at eleven o'clock. The colors were constantly changing their hues. From all the northern, eastern and western parts, the flashing light rose to the vertex, and seemed to shoot back again as it came. Often the light would flash through thirty or forty degrees, disappear within twenty degrees of the vertex and reappear flashing as before, for the last ten degrees, as if it passed for ten degrees behind some opake substance. The sky was cloudless for the whole time. At a quarter after eleven the red light disappeared, while long, arrowform, splendid streams continued to play for some time till they gradually subsided and only a luminous sky remained for most of the night. On the next evening, there was a slight aurora. Whatever of beauty, splendor or grandeur, others may have seen in this phenomenon, no aurora has ever come under my observation of equal brilliancy and variety.

Rochester, July, 1837.

2. *Observations made at New Haven, and elsewhere.*

This very brilliant display of northern lights was witnessed as far south as Columbus, Ga. (lat. about 32° 35′ N., long. 85° 11′ W.) It was seen there for about half an hour, commencing at 9*h.* 30*m.* Many streamers of a red color were observed, but their altitude is not stated. We have also observations of the phenomena from Cleveland, Ohio; Fayetteville, N. C., and various places in Virginia, which, so far as they go, substantially agree with those made here. At Richmond, the display between two and three A. M. of the next morning, was distinctly noticed by a friend who happened to be there; but the printed statements make no mention of it. The observations below given, were made by several persons of this place, and are in the main the same as were published in the [New Haven] Daily Herald of July 6, 1837. E. C. H.

An Auroral display of unusual variety and splendor was witnessed in this city on the night of Saturday last, the first of July. The day was one of the warmest of the season: at 2 P. M., therm. 84° Fah.; wind S. W. Towards the latter part of the afternoon, dark clouds arose in the northwest and gave promise of a thunder storm, but about an hour before sunset they passed off to the northeast without much rain. At 6 P. M. therm. 78°, barom. 29.67 in., wind light from N. N. W.

At 9*h*. 25*m*. just before the departure of twilight, the northern sky was observed to be faintly illuminated from W. N. W. to N. N. E., but much obscured by clouds. It soon became clear. At 9*h*. 38*m*., streamers began to form in the N., and soon after in N. E. and N. W., gradually becoming more frequent and increasing in brilliancy. At 10*h*. 30*m*., the action was most energetic, and the scene eminently animated and beautiful. From E., N., and W., and all points between, streamers shot up from near the horizon in quick succession, with wonderful celerity and passed beyond the zenith, while others starting from an altitude of about 30° in the S. met the former about the corona in the constellation Ophiuchus. Auroral waves soon appeared, flashing upwards with great rapidity across the streamers and rolling up in wisps and sheets around the coronal point. The color of the streamers and waves was mostly a phosphoric white, but about 10*h*. 40*m*. for a short time a fine rose-red predominated.

At 11*h*. 10*m*. the display was on the decline. By midnight it became quite faint, and the heavens were at the time much obscured by clouds. About this period the light was mostly confined to the eastern horizon, where among the clouds were seen indistinct columns of red and white. About 1*h*. A. M., (July 2d,) the clouds dispersed, and the sky became exceedingly clear, and thus continued during the remainder of the night.

At 2*h*. the Aurora began to revive, and soon presented a spectacle in many respects surpassing the former. At 2*h*. 10*m*. an indistinct arch about a degree wide, appeared, with vertex about 8° high in the N., between which and the horizon, the sky, although clear, seemed to be covered with dark vapor. From this arch arose broad streamers of a vivid yellowish white. Some of the streamers, however, occasionally started from points in the dark space below the arch. About 2*h*. 30*m*., the display was at its maximum. From W. N. W. to E., the sky was filled with streamers, passing over head, and forming a corona in the constellation Cygnus. Along these columns or streamers, swept upwards immense auroral waves, nearly unbroken from the horizon to the magnetic equator. These columns remained in unabated splendor for fifteen minutes, and were visible until about 3. At 2*h*. 38*m*. the arch was extinct, and the streamers were becoming shorter and less frequent. They were, however, for a long time, numerous about the N., and were visible until overpowered by the superior light of the advancing sun. They were distinctly observed as late as 3*h.* 30*m.*, or about an hour after day break.

Many observations on the position of the corona were made during the night: those which are the most trustworthy are the following, viz.

2*h.* 31*m.*	centre of corona,	alt.	75°	25′	azim.	S.	4°	27′ E.
39	"	"	74	55	"		3	30
42	"	"	74	40	"		5	07

These positions correspond nearly to the direction of the dipping needle at this place, if we make due allowance for the perturbations which the Aurora may have occasioned, and for the difficulty of determining with precision the central point.

The horizontal needle was much disturbed. Between 10*h.* 44*m.* and 11*h.* it traversed 3° 4′. In general, the north end of the needle was carried to the east of its mean position at this place, which is now about N. 5° 55′ W. After midnight, the range of variation did not exceed one degree. The needle was not observed on the 2d or 3d inst.

From sunset to 2*h.* 30*m.* the wind was from N. W. and faint; after that time, from N. N. W. and somewhat stronger. At 11*h.* 40*m.* the dew point was 67°, therm. being at 72°. The barometer rose during the night: at 2*h.* 30*m.* A. M. (2d inst.) it stood at 29.76, at 6*h.* 29.80. Thermometer at 2*h.* 30*m.* 71°, at 6*h.* 69°.

It is worthy of notice, that on this occasion there were two well marked and distinct *seasons of greatest brilliancy* or *fits of maximum intensity*, at an interval of about four hours. It will be found on examination of former accounts, that this is a common feature of Auroral exhibitions of unusual brilliancy, and that the first fit occurs within about an hour after the end of twilight. Future observations continued during the entire night, must determine the number of these seasons and the interval between them.

The Aurora appeared on the night of Sunday, 2d inst. and was observed until 1*h.* 30*m.* of the 3d inst. It was not very conspicuous. At 9*h.* 30*m.* there appeared a low dim arch, with vertex about 5° high, sending forth occasional streamers to an altitude not exceeding 30°, after which no special change was noticed. The day was clear and fine; therm. at 2 P. M. 78°.

On Monday night, 3d inst. the Aurora was again seen. It was less conspicuous than on the 2d. The evening was showery, but at 9*h*. 45*m*. the clouds began to disperse. The North was illumined with a faint light, now and then adorned with a solitary streamer. Observations were continued until near midnight, but no increase was seen.

The hours and minutes above given are of apparent time.

A. C. C. E. J.

ART. XV.—*On Spontaneous Combustion;* by JAMES MEASE, M.D.

IN my "Archives of Useful Knowledge," vol. iii. p. 167, I recorded three cases of the spontaneous combustion of large masses of bituminous coal from Virginia, two in cellars, and a third under a close arch, all of which occurred in Philadelphia.* A fourth case was stated of one thousand two hundred chaldrons of coal "in a close compact magazine" in Paris, and a fifth of one thousand six hundred tons of the same article in the royal ship-yard in Copenhagen and all consumed, together with one thousand four hundred houses. This happened in the year 1794.†

Bituminous coal has on other occasions taken fire. In the year 1822, October and November, three cases occurred of this in the navy yards of Brooklyn, New York, Portsmouth, New Hampshire, and Washington city. The coal was from Virginia, and lay exposed to the air and rain.

In the year 1828, one hundred chaldrons of coal which had been placed several weeks before on wet ground in Boston, took fire, with a volume of sulphurous matter rising in a state of ebullition. It was remarked that this was the third instance of the kind within the past year in that city.

Another case was mentioned in the newspapers as having taken place in Ridgley's coal-yard, Baltimore, some years since, in the month of August. This coal also was doubtless from Virginia. A similar accident has recently occurred in the coal yard of Nutter & Co., New York, to sixty tons of Virginia coal. (July, 1837.)

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* This last was from Dr. Seybert's paper on Spontaneous Combustion, in New York Medical Repository, Hexade 3d, vol. iii. Two similar facts are given by Bartholdi, *Annales de Chimie*, No. 144: and translated in Tilloch's Philos. Mag. vol. xviii.

† In my additions to the article "Inflammation," in Willich's Domestic Encyc., I have given nine cases of spontaneous combustion from various causes.

Mr. Dupont, the late extensive manufacturer of gunpowder, informed Dr. Seybert, that charcoal was also liable to spontaneous combustion when in powder and piled in a heap. He had suffered loss from this cause, and a similar accident had occurred near Paris.

The French commissioners charged by the French government to examine into the causes of the explosions of powder factories, ascertained that charcoal in the lump, by attrition took fire. Charcoal inflames according to M. Caussigni, by the pressure of millstones, and has taken fire in the box of the bolter, into which it had been sifted; the coarse powder experienced no alteration.—*Annales de Chimie, No.* 35.

Mr. Sage saw the roof of one of the low wings of the mint at Paris set on fire by the spontaneous combustion of a large quantity of charcoal that had lain in the garrets.

Two instances of spontaneous combustion took place in the powder manufactory of Essone, in the year eight and ten of the French republic; the first in the box for sifting the charcoal, and the second in the charcoal repository. Bartholdi attributes them to phosphorus in the charcoal.

May not one or more of the conflagrations of powder mills, which have taken place in the United States during the two past years, have been caused in this way?

Linen, cotton, and woolen cloth, or the raw materials of these fabrics impregnated with flax-seed oil, or paint, or varnish, have frequently proved the causes of spontaneous inflammation.

Several years since a piece of canvass, forty yards in length, painted with white lead and oil, and exposed to the sun for some hours, was rolled up and put under cover. The next morning it was found smoking, and the whole except a yard, burnt to cinder, with a hole through the bottom of a wagon. This happened at Mount Pleasant, Virginia. A large piece of coarse muslin, thoroughly oiled for the purpose of making covers for boxes, was left over night, folded loosely in a shed in a yard in Market street, Boston; in the morning, it was found burnt entirely through, and about to blaze. (1831.)

A quantity of wool prepared with the usual proportion of oil for carding, and thrown into a heap in the evening, was found the next morning ignited, and the floor to a considerable extent on fire. This happened at Hamlin & Bates' factory; and another instance occurred at the establishment of Warner & Whetton.* Lamp oil was used. (1831.) A quantity of cotton clothing for seamen's suits, had been oiled and hung up at Duxbury, Massachusetts, for a fortnight to dry, and were then taken down, rolled together, and placed in a shed; the next day they were found on fire. (1831.)

The Schr. Hiram, laden with wool, when on a voyage from Bilboa to New York, in March, 1825, was set on fire, in consequence of some linseed oil having been spilt on the cabin floor.

Two pounds of wool greased with flax-seed oil, near Germantown, Pennsylvania, set fire to the building next morning. (1818.) The closet in which the paint and oil were kept at Boshor's carriage factory, Richmond, Virginia, having been smeared with linseed oil, burst out in a flame. (1832.)

Some cotton used in cleaning the cabin of the ship Birmingham, became partially filled with flax-seed oil, and after some time it ignited. An express experiment proved that cotton thus impregnated would inflame in two hours. (New York, 1831.)

Cotton rags, while delivering from the cellar of a store, 24 Broad street, New York, were found on fire. Oil had been spilt on them. (June, 1834.)

Mr. Durant's large balloon, varnished for the first time, exposed to the sun through the day, and rolled up in the evening, and deposited upon chairs in a house in Jersey City, was found the next morning entirely consumed. The varnish was composed of oil, turpentine and caoutchouc. (June, 1832.)

Mr. Atkinson of Ellicott's mills near Baltimore, stated that flax-seed oil spilt on [wood] ashes in an iron kettle, caused the ashes to inflame in twenty four hours. He made an experiment to test the fact, with success. Mr. Patterson, President of the United States' Mint, repeated the experiment with cold hickory ashes, and one pint of flax-seed oil; in forty six hours after, the mixture was fairly ignited, and in a short time emitted flame, which continued upwards of an hour. After the flame had ceased, the ignition continued for eighteen hours, and the ashes were then poured out of the vessel. (1820.)

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* Both at Plainfield, Massachusetts. Ample experience has taught European manufacturers that no oil should be used for greasing wool, but that of rape seed,

A canvass recently painted with flax-seed oil, and then dried and rolled close, took fire after being three hours exposed to the sun on the deck of the Schr. Olive, at Troy, New York. (August, 1820.)

A piece of old packing-sheet, which had lain long about an oil and color warehouse, and was besmeared with different kinds of vegetable oils, on being thrown behind some casks pretty much confined from the air, inflamed.—*Edinburgh Phil. Jour.* vol. vii. p. 219.

A cask of oat meal left from May to August in a kitchen in Glasgow, caught fire and was totally consumed together with the barrel. —*Thomson's Annals*, vol. xvi. p. 390.

A parcel of hops well dried, were put into a home-spun cotton gown and placed on a heap of cotton seed; after three months they inflamed. Cotton it was remarked has frequently been known to take fire spontaneously in a moist and heated atmosphere.—*Milton, N. Carolina paper.* (1824.)

Certain ochres ground in flax-seed oil, inflamed during the act of trituration.

Alder charcoal has taken fire in the warehouses in which it was stored.* One of sixty three casks of lampblack on board the ship Catherine, bound to India from England, ignited, but was discovered by the fumes before it had burst into a flame.—*Old Monthly Mag. Lon.*, 1827, p. 91.

Wet Cotton.—The ship Earl of Eldon, in August, 1834, was set on fire, by reason of having shipped cotton in the rain at Bombay.

A similar occurrence took place in 1836, on board a vessel which had taken in cotton at Apalachicola, Florida, during rain.

A piece of red cedar about two ounces in weight, broken in two, and laid upon the shelf of the store of Mr. Adam Reigart in Lancaster, Penn. inflamed after two years had elapsed, in June, 1834. It was part of a tree found in excavating the deep cut of the rail road, at the "Gap in the Mine Ridge," Lancaster County, thirty feet below the surface. The combustion was proceeding so rapidly, that the shelf would have been in a few minutes on fire, and it evidently commenced in the interior of the wood, as some of the outer fibres were sound.—*Hazard's Register of Pennsylvania*, vol. xiii, p. 399.

Haussman relates that several dozens of skeins of cotton, dyed red, and impregnated with an alkaline solution of alumina, with excess of boiled linseed oil, were placed on a straw-bottomed chair, under a window, and at midnight they inflamed.*

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* B. G. Sage. Walker's Archives, vol. iii., p. 80.

A heap of horse manure inflamed in the month of May, 1822, at Sharon, in Connecticut. The fire was two feet in circumference. *American Journal of Science*, vol. v, p. 201.†

ART. XVI.—*Notice of "A Report on the Geological Survey of the State of Connecticut;* by Prof. CHARLES UPHAM SHEPARD, M. D., &c. &c."—*with extracts and remarks*, by the EDITOR.

IN consequence of a recommendation by his excellency Gov. Edwards, the Legislature of Connecticut, in May, 1835, resolved—that the Governor be, and he is hereby authorized to appoint a committee of suitable persons to make a geological survey of the State of Connecticut, and to report the same to the General Assembly at their May session of 1836. In consequence of this resolution, the Governor appointed Dr. James G. Percival and Prof. Charles U. Shepard to make and report on the proposed examination.

These gentlemen having divided the labor, Mr. Shepard has reported on the economical mineral resources, and on the scientific mineralogy of the State.

Dr. Percival's report on the geology, is, by permission of the legislature, deferred another year, that he may have time to finish his work.

It is impossible for any competent judge of the matter to peruse Mr. Shepard's report without being convinced that he has brought to the task all the industry, perseverance, and science that were demanded, and that he has been particularly attentive to the practical interests of the community. The result of this examination, as far as it is completed, does much honor to those who recommended, and to those who executed it, and we shall now give an analysis of the report of Professor Shepard, with copious extracts, since the details are numerous and important, and do not always admit of abridgment.

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* His theory of this is as follows: "In all cases where the oxygen of the atmosphere is rapidly attracted and absorbed, the caloric, which serves as a base to the oxygen, giving it the qualities of gas, or elastic properties, is disengaged in such abundance, that if the absorbing bodies are susceptible of taking fire, or if combustible bodies are in the neighborhood, a spontaneous inflammation will take place."—*Annales de Chimie, No.* 144. *Tilloch, Vol.* 18.

† It appeared subsequently, that this case of supposed spontaneous combustion was the work of an incendiary; the communication of both facts was from the same person, a respectable physician.—*Editor.*

In his introduction, after giving credit to those who have preceded him in examining the mineral resources of Connecticut, Prof. Shepard remarks—"I am far from entertaining the opinion that her mineral wealth is yet fairly laid open to view. On the contrary, a glance only has been obtained, but enough it is believed, to awaken fresh zeal and confidence in relation to what remains concealed.

"The opinion which has until recently prevailed respecting the metallic treasures of Connecticut was certainly erroneous. Her iron mines have often been represented as fast tending to exhaustion, and her iron manufacture as being attended with little advantage. One of these mines however, has long yielded its proprietors a clear annual profit of about five thousand dollars; while many handsome fortunes have been realized from the iron business in that section of the State. Instead of a failure in the supply of ore, it may confidently be asserted, that not one half of the workable beds in that district are as yet fairly uncovered; while it is equally true, that as soon as proper economy in the burning of charcoal and the radical improvement of the hot air-blast are introduced, cast iron will be afforded at one half its present cost, and this without any diminution of profit to the manufacturer. An iron resource also, of great value, in the steel-ore of Roxbury, has hitherto been wholly unappreciated. And if our copper region has not as yet been a source of income to the State, it is not surely because we are deficient in this valuable metal, as the plainest indications show; but for the reason that enterprise and capital have been wanting to open these deposits: for workable veins of copper, unlike the other metals, rarely attain the surface of the earth. The neglect of these mines however, until the present time, will prove less a detriment to the public wealth from the fact, that the working of deep mines (in consequence of the economy introduced into the system of furnishing supplies requisite to such undertakings, and the saving of power in the improvement of the steam engine) is now carried on, at less than one half the cost incurred twenty-five years ago. Cobalt, zinc, lead, bismuth and silver, are also to be included on the list of metals which will one day augment the wealth of the State; nor are the indications of tin, a metal most of all to be desired, wholly wanting. Without wishing by unauthorized statements to allure the inconsiderate, and those not possessed of the necessary resources, into a branch of business where the chances of success would be greatly against them, I still feel it a duty to give it as my decided conviction, that the iron and copper mines of the State constitute a legitimate object for the investment of capital; and that if the enterprise of opening these resources is committed to persons of integrity and skill, it must prove eminently remunerative in its result, both to those immediately interested and to the population generally. For it is most obvious, that the working of rich mines will not only react in a favorable manner on the agricultural interest, by advancing the price of farming produce, but will also promote the public prosperity by leading to the free circulation of capital, the improvement of roads, and to habits of increased industry in the people.

"The advantages possessed by the State in respect to materials for architecture, decoration and porcelain,—for flagging, quicklime and cements,—if on the whole better known and admitted than those connected with her metallic resources, are still far from being appreciated to their full extent. This report it is hoped will make it evident, that they are not only bestowed upon us with a liberal hand, but that they have their value greatly enhanced by the topographical features and geographical position of our territory. The Sound affords a navigation secure almost as a river along the whole face of our southern boundary, while the Connecticut flows like a canal across the center of the State, and smaller streams and harbors cleave and indent the coast. Large and growing maritime cities must still continue to depend upon us for the supply of much of their most valued architectural materials; and in the improvement of harbors and the construction of fortifications, we are doubtless destined to contribute as largely as heretofore. To an agricultural people, the possession of so many quarries under such circumstances, is peculiarly favorable; surpassing perhaps in direct advantages to them, the existence of mines. For the working of these, together with the smelting of ores, are arts of slow and difficult acquisition, requiring in many instances the investment of an immense capital, which, in the fluctuating successes that often attend such operations, must sometimes remain unproductive for an entire generation. But the working of a stone quarry is little more than a branch of agriculture. A farmer, supplying himself with a few additional instruments and materials, may work his ledges as well as his soil, according as one or the other rewards him best for his labor; or he may manage both, without prejudice to either. His labor in each case, is alike conducted in the broad light and fresh air of open day.

"As it appeared important to connect with this report whatever seemed likely to promote the future development of valuable minerals in the State, I have felt myself called upon to introduce occasional details respecting the uses of minerals not commonly understood, and also to give very briefly the rules for detecting and recognizing such substances. And as encouragement to research, as well as for the purpose of making the public generally acquainted with our resources, I have included frequent statistical notices relating to the number of hands employed in various mines and quarries, and to the amount of products annually afforded.

"How far the results I am herewith able to submit concerning the economical mineralogy and geology of the State will be thought valuable, I am unable to predict. I have however, discharged this part of my duty to the best of my ability, though the restricted period allowed, has compelled me to content myself in many instances with hasty examinations and brief descriptions. That there was room for the performance of many useful services in affording information to individuals in different parts of the State who were occupying themselves with mineral explorations, I am abundantly satisfied; and both my colleague and myself have the satisfaction of knowing, that we have dissuaded from many profitless enterprises not a few of our fellow citizens who stood in need of such advice, while we hope that we have been able also to furnish suggestions to others that will ultimately be promotive of their interests. Without wishing to speak disrespectfully of a community which has never been placed second to any other in the Union for its widely diffused intelligence and general sagacity of character, I may still be permitted to say, that information relating to the mineral kingdom was almost every where found to be singularly deficient. Other communities no doubt share with us in this defect. Many persons, not otherwise wanting in intelligence, were met with, whose belief in the virtues of the divining rod was unshaken; iron-pyrites was often explored for gold, talcy rocks were ground for plaster, and plumbaginous mica-slate extensively mined for coal! Most fortunate would it have been, could this deficiency have been supplied at an earlier period, as it could not have failed to check an immense expenditure of labor which has been worse than thrown away; since it has always operated more or less to interrupt the industry of neighborhoods, and to bring into unmerited discredit even scientific researches connected with the mineral kingdom.

"A scientific report, embracing notices of all the simple minerals of the State, independently of their relations to the other sciences or even to the arts, though uninteresting to the general reader, still seemed to be demanded, not only to supply the wants of the many students of mineralogy in the public institutions of the State where the science is taught, but also for the purpose of indicating with accuracy the numerous productions which still lie dormant as respects any useful applicability, but which the progress of the arts may ere long call into requisition. It may be added also, that it was presumed the scientific community generally, were in the expectation of finding in this report a summary at least of the leading features of our mineral productions, since mineralogy has longer been cultivated and taught as a branch of education here, than in any other section of the country. The subject, for want of space, has necessarily been treated in an imperfect manner; though I venture to hope, that inasmuch as many of the facts are new, it will not be found wholly devoid of interest to the mineralogist. It was certainly an unexpected result to myself, to be able to detect in so small a territory as that of Connecticut, and one whose strata had been so little perforated by mining operations, nearly one half of the well established mineral species hitherto discovered thoughout the world, and fully three quarters of all the elements as yet made known to us by chemical analysis; much less was it anticipated at the outset, that it would become necessary, in the progress of this work, to add several new species to the productions of the mineral kingdom."

Mr. Shepard's labor is included under the three heads,

Economical Report, Scientific Report, and Descriptive Catalogue.

Under the Economical Report, there are the following divisions—1. *Metals*, 2. *Coal*, 3. *Plumbago*, 4. *Gems*, 5. *Polishing and Grinding Materials*, 6. *Soapstone and Potstone*, 7. *Materials for Alcaline and Earthy Salts*, 8. *Materials for Bricks, Pottery, Porcelain and Glass*, 9. *Fire-stones*, 10. *Fluxes*, 11. *Quick-lime and Water-cement*, 12. *Stone-Paints*, 13. *Decolorizing carbonaceous slate*, 14. *Materials for Architecture and Decoration*, 15. *Materials for Flagging, Tiling and Paving*, 16. *Mineral Springs*, 17. *Materials for Agriculture.*

The State possesses many good deposits of iron ore.

Of *Magnetic Ore*—there is a powerful bed at New Preston, on land of Alvan Brown—in the Buck Mountain, on the Housatonic river—in Reading, on land of Mr. Gregory.

Magnetic iron is found also at Judson's quarry, Newtown—in Winchester, &c.

Magnetic iron sand is found on the sea board, from New Haven quite to Stonington Point, and even beyond, upon the Rhode Island coast. It is derived from the rocks that border the Sound, and at Seldon's Point, in Hadlyme, it is found in place in granite, constituting sometimes one-fourth or one-third part of the rock.

Hematite in all its varieties, and *bog iron ore*, are found in many parts of the State. They contain from one-half to four-fifths their weight of peroxide of iron.

"The fibrous brown hematite, compact hematite, and the ochrey mixtures of the two, are generally confined to primitive rocks, as gneiss and mica-slate. They afford materials for very large iron-works in many countries, and are universally regarded as the best ores for yielding a malleable iron, and for being easily converted into steel. Although these ores (which may be referred to under the general name of hematite) are confined to a limited district of the State, they nevertheless appear to constitute its richest metallic resource. The towns in which they exist are Salisbury, Sharon, and Kent; and the principal deposits hitherto explored, are those of the "Ore-hill," Salisbury,—the Indian pond ore-bed, Sharon,—and the Kent ore-bed. The two first form beds in mica-slate; the last in a micaceous gneiss and quartz-rock. At Sharon and Salisbury, the ore is disposed in vast beds with a stratification every where obvious, and perfectly conformable to that of the adjoining mica-slate. It is moreover, free from secondary aggregates. At Kent on the contrary, the order of arrangement is less visible in the bed, which at first view appears to be a confused accumulation of broken, decomposing (and in some instances re-cemented) rock, at the foot of a high ledge.

"The Ore-hill mine of Salisbury, is by far the most important of these deposits. It is situated about two miles west of the Furnace-pond, and covers an area of several acres, forming the southeastern slope of a slight elevation of land. It is worked like a quarry, open to the sky. The entire surface of the slope is destitute of vegetation, and every where excavated by diggings and pits."

"The ore is reduced in high furnaces, and yields on an average from forty to fifty per cent. of pig-iron. This is principally converted into bar-iron at the furnaces where produced, or at the forges in Winsted and Canaan, and is there manufactured into bar-iron for musket and rifle-barrels, and for common uses for the blacksmith; anchors, axle-trees, iron-bars and tires for wheels, irons for grist and saw-mills, shafts for steam-engines and manufactures of all kinds; large screws for clothiers, paper-makers, and for pressing bales of cotton and hay. The best Salisbury iron has obtained a decided preference over all other iron, either foreign or domestic, for the construction of musket and rifle-barrels.

"The Kent bed was formerly considered as a very important deposit of ore. It supplied several extensive forge establishments for a great number of years with ore of an excellent quality; but partly in consequence of the unskillful and improvident manner in which the original workings were conducted, and partly from the limited extent and peculiar situation of the bed, it has now sunk into almost total neglect. It is situated on the western declivity of a low mountain, near its base. In length the mountain is about three miles, and in height two hundred feet. Its length corresponds with the edges of stratification in the vicinity, which do not differ essentially from north by east.

"At present the workmen are directing their attention to a more recent opening, situated seventy or eighty rods north of the old mine, on the same slope and at the same elevation above the valley. It has been worked more or less for a period of thirty years. Until lately, the ore was obtained exclusively by burrows; but they have now formed a deep drain, open to the air as at the old bed, and from the sides of this drain they carry in burrows, where the workmen operate to advantage during the winter.

The following is an approximation to the annual yield of furnaces in cast-iron in this section of the State:—

	The ore from N. Y.	The ore from Conn.
"Housatonic manufacturing co.,	500 tons.	
Macedonia furnace co., -	850 "	
Kent furnace co., -	600 "	
Sharon valley-furnace, -	-	800 tons.
Raumaug iron co., -	500 "	
Chapinville, - -	-	400 "
Canfield & Robbins, -	-	400 "
Cornwall iron co., -	-	500 "
Cornwall-bridge iron co., -	-	1000 "
Limerock furnace, -	-	400 "
Mt. Riga, - -	-	500 "
	2450	4000"

About 900 tons of ore go annually from the Salisbury beds to the Ancram iron works, and 300 tons of the Kent ore are consumed near the ore bed.

The annual produce of cast iron from the hematite of the State, may therefore be estimated at 4500 tons.

Mr. Shepard has the following valuable remarks and citations on the subject of the manufacture of iron.

"In the fabrication of cast-iron it must be obvious, that a certain temperature is necessary to secure the favorable working of the furnace. If this is not reached, all the stock added, is (in the language of the furnace-men) "cut to pieces" without any reduction of the metal. The manner in which the hot-blast secures the heat required, is at once understood if we reflect upon the ascertained fact, that in a furnace whose charges of stock amount to two tons per hour, the weight of air driven in, is six tons for the same time. The difference between the admission of this prodigious weight of air at 50° and 600° is most apparent, especially when it is considered that it enters the hottest part of the furnace. In both cases, the effect it produces to support combustion is the same; in the latter, however, it does not rob the combustion of the heat it produces. But before quoting the verification of the rationale given, and which experience has furnished, it is proper to allude to the method by which the air is heated, and to state how it is forced into the furnace. A number of arrangements have been adopted in Scotland for heating the air, but no one in particular seems hitherto to have proved itself superior to the rest. In general, the method may be described to consist, in maintaining at a red heat, the cast-iron tubes through which the air from the blowing apparatus to the furnace is conveyed. But as the temperature of the furnace near the nozzles becomes so much elevated, it is necessary in order to prevent the melting of the cast-iron lining to employ the water-tweer; which consists of an iron lining, cast hollow instead of solid, so as to contain water within, which is admitted by means of one pipe, and allowed to escape by another as it becomes heated. It thus becomes practicable to lute up the space between the blowpipe nozzle and the tweers, whereby all loss of air is prevented, and the bellowing noise formerly produced completely suppressed.

"To exhibit in a satisfactory point of view the operation of this arrangement, the results obtained at the Clyde iron-works, in Scotland, may be instanced.

"'During the first six months of the year 1833, when all these changes had been fully brought into operation, one ton of cast-iron was made by means of 2 tons 5¼ cwt. of coal, which had not previously to be converted into coke. Adding to this 8 cwt. of coal for heating, we have 2 tons 13¼ cwt. of coal required to make a ton of iron; whereas in 1829, when the cold blast was in operation, 8 tons 1¼ cwt. of coal had to be used. This being almost exactly three times as much, we have from the change of the cold blast to the hot, combined with the use of coal instead of coke, *three times as much iron made from any given weight of splint coal.*

"'During the three successive periods that have been specified, the same blowing apparatus was in use; and not the least remarkable effect of Mr. Neilson's invention has been the increased efficacy of a given quantity of air in the production of iron. The furnaces of Clyde iron-works, which were at first three, have been increased to four, and the blast machinery being still the same, the following were the successive weekly products of iron during the periods already named, and the successive weekly consumpt of fuel put in the furnace, apart from what was used in heating the blast:—

				Tons.			Tons.			Tons.	
In 1829,	from	3	furnaces,	111	Iron,	from	403	Coke,	from	888	Coal.
1830,	“	3	“	162	“	“	376	“	“	836	“
1833,	“	4	“	245	“				“	554	“

"'Comparing the product of 1829 with the product of 1833, it will be observed that the blast, in consequence of being heated, has reduced more than double the quantity of iron. The fuel consumed in these two periods, we cannot compare; since in the former, coke was burned, and in the latter, coal. But on comparing the consumpt of coke in the years 1829 and 1830, we find that although the product of iron in the latter period was increased, yet the consumpt of coke was rather diminished. Hence the increased efficacy of the blast appears to be not greater than was to be expected, from the diminished fuel that had become necessary to smelt a given quantity of iron. On the whole then, the application of the hot blast has caused the same fuel to reduce three times as much iron as before, and the same blast twice as much as before. The proportion of the flux required to reduce a given weight of the ore has also been diminished.'

"'In Scotland, Mr. Neilson's invention has been extensively applied to the making of cast-iron, insomuch that there is only one Scotch iron-work where the invention is not in use; and in that work, apparatus is under construction to put the invention into operation.'—(*On the application of the Hot Blast, in the manufacture of Cast Iron, by* THOMAS CLARK, M. D., Professor of Chemistry in Marishal College, Aberdeen. Transactions of the Royal Society of Edinburgh, Vol. xiii, p. 373.) For additional details respecting this improvement, see a treatise 'on the use of hot air in the iron-works of England and Scotland, translated from a report made to the Director General of mines in France, by M. DUFRENOY, in 1834. London. Murray. 1836.'"*

Bog ore is abundant, and has long been wrought in the State, particularly in the central and eastern parts.

The iron works of Stafford produce 350 tons of cast iron annually—but a part of the iron comes from Massachusetts.

Spathic iron.—Of this ore, there is a great deposit at Roxbury, near New Milford. This ore consists of more than half protoxide of iron, and the rest is carbonic acid with a little manganese, lime and magnesia.

This mine was wrought, many years ago, for silver, and then deep and expensive excavations were made, of the origin of which Mr. Shepard has given an interesting account. This ore is usually called the steel ore, because it affords steel directly from the bar without cementation, and its nature has in this case been repeatedly verified of late years by the fabrication of cutting instruments from it.

Iron pyrites are found in many parts of the State, and the magnetic variety in abundance in the towns of Trumbull, New Fairfield, and Litchfield; in the latter town, it is particularly abundant. It is easily converted into copperas, but as yet there is no manufactory similar to that which is so well known at Stratford in Vermont, 12 miles west of Dartmouth College.

Copper.—Most of the ores of copper are found in Connecticut; and there have been many exportations, particularly in the early part of the late century.

A mass of native copper, weighing nearly 100 pounds, was found a few miles from New Haven, many years ago; and more recently (about 20 years ago) near Wallingford, one weighing 6 pounds, which is in the cabinet of Yale College, and it has been discovered repeatedly in Farmington. The excavations formerly used as a State Prison, in Granby, were made a century ago, in digging for copper, and since the removal of the convicts to Wethersfield, this mine has been wrought again.

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* The greater part of the extracts commencing at the top of the preceding page, was printed in Vol. xxxi, at p. 181 of this Journal, but we allow them to stand here again for the sake of the connexion.

"The following is the report of Mr. John B. Jenkins of Swansea, Wales, of his trial made in 1830, upon four parcels of the ore:—

		cwt.	qrs.	lbs.		per cent.		cwt.	qrs.	lbs.
"'No. 1,	wt.	4	1	17	produce	$13\frac{1}{2}$	metal	0	2	5
2,		4	2	4		$12\frac{1}{8}$		0	2	2
3,		4	1	4		$4\frac{3}{4}$		0	0	21
4,		4	2	24		$10\frac{7}{8}$		0	1	26
		17	3	21				1	2	26

"'The quality of the copper in each parcel is very much the same, and may be said to be of the average quality of English copper; but their smelting qualities are below the average, being rather refractory. The expense of smelting the above ores, per ton of 21 cwt. will be for No. 1, £2 11 9; No. 2, £2 9 9; No. 3, £1 18 8; No. 4, £2 8 0, exclusive of all custom house charges. The ores, if there were any quantity of them now for sale, would bring the following prices, viz:—

"'No. 1, about	£9	9	6	At the present rate of exchange,	$44 84
2,	8	9	6		40 10
3,	2	19	6		14 08
4,	7	9	6		35 38
Average,	£7	2	0		$33 60

"'These are the prices as near as I can judge of them, or as much as a smelter could now give for them at Swansea, the miners to pay freight to this place, and all expenses of ware-housing, sampling, &c. &c.'

"In order to show the richness of these ores when compared with those of Cornwall, the following statement of the produce of the English mines for three years, is subjoined from the same document."

Years.	Tons of ore.	Tons of cop.	Rate p. c.	Value per ton.	Total value.
1815	79,984	6,607	$7\frac{8}{10}$	£6 13 0	£532,108 0 0
1816	82,442	6,968	8	6 10 5	537,621 0 0
1817	73,727	6,608	$8\frac{4}{10}$	6 11 6	410,936 0 0

Variegated copper ore, in rich veins, has been uncovered by G. W. Bartholomew, in Bristol; the veins are in a granitic rock and in place, and it is suggested by Mr. Shepard, that the copper found in the red sandstone and in the trap of Connecticut, may have resulted from the breaking up of a regular formation of copper in the primitive.

Copper ore is found in Hamden and Cheshire, near New Haven, as well as in many other places. In addition to the forms which have been enumerated, we may mention vitreous copper, yellow copper pyrites, and the green and blue carbonates. For many details relative to the indications of copper in Connecticut, we must refer to the report itself.

Lead.—The number of places where lead has been found is very considerable, and mines have been wrought at Middletown, Wilton, &c. Some very rich specimens were brought, a few years since, to Yale College, from Brookfield, but they appear not to have belonged to a continuous vein. Lane's mine, in Monroe, is worthy of commemoration, on account of the large proportion of silver—from 2 to 3.5 per cent. of the metallic lead; this ore is not hitherto abundant, but the mine has been merely opened, and not wrought deeper than a few feet. Since the proportion of silver is so large, this deposit of argentiferous galena ought to be explored.

Zinc.—Blende, or the sulphuret of zinc, is found in various places, and calamine (the carbonate) in small quantity at Brookfield; cadmia, an oxide of zinc, sublimes in the iron furnaces of Salisbury.

Native Bismuth is found at Monroe.

Arsenic—in the form of arsenical iron, (mispickel) exists at Derby, Monroe, Chatham, Wilton, &c.

Cobalt and Nickel are found at Chatham.

Molybdenum in Haddam.

Titanium—in Monroe, Plymouth, Granby, North Greenwich, and Middletown.

Uranium, in the feldspar quarry, Middletown.

" *Columbium.*—The State of Connecticut furnished the first sample of this ore to science; and in consequence of its American origin it received in England the name of columbite, and the new metal it was found to contain, that of columbium.

" The china-stone quarry at Middletown has furnished the most extraordinary specimens of columbite yet described in the world. A single group of crystals obtained at this place weighed fourteen pounds.* It occurs in crystals disseminated through the feldspar, many of which are very remarkable, not only for their size, but for their perfection of form. It is also found in small quantity at Haddam, in the granite-vein which contains the chrysoberyl.

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* See this Journal, Vol. xxx, p. 387.

"The first sample was sent by Gov. WINTHROP to Sir HANS SLOANE, and was deposited with the collection of this gentleman in the British museum, where it was examined by Mr. HATCHETT, and afterwards by Dr. WOLLASTON. The specimen was supposed to have been found near New London, which was the residence of Gov. WINTHROP; but as the ore has not been re-discovered in that vicinity, it is more probable that it was obtained from the region of Middletown."

Tungsten is found at Monroe—both the wolfram, ferruginous tungsten, and the calcareous, besides the free oxide, which was there first identified.*

Coal.—Connecticut being mainly a country of primary rocks, and accordingly, in three quarters at least of our territory,—in all but the secondary region of the valley of the Connecticut, and the limited basin of Woodbury and Southbury,—the existence of coal is as certainly denied as that of rock salt in the same district.

"The great central valley of the Connecticut abounds in a conglomerate-rock, obviously composed of fragments derived from the contiguous primitive; nor is it wholly wanting in bituminous shales and dark colored sandstone-slates, which are the more immediate attendants of coal deposits. Still these have not yet been found collectively arranged in that order of alternation, and penetrated and interleaved by vegetable remains and argillaceous iron-ore, circumstances which are at least requisite to constitute safe indications for boring. The hopes that have been entertained have been founded chiefly on bituminous shale and limestone, black fissile slate, and thin interrupted seams and grains of indurated bitumen in sandstone and amygdaloid.

"Impressions of plants are of very rare occurrence at the places where excavations have been made, and in many instances altogether wanting. A cupriferous sandstone-slate in Suffield at Enfield falls, occasionally embraces compressed stems, apparently of calamitæ, which are converted into brown coal. Similar remains were noticed at Southington, in one of the quarries of hydraulic lime. The coal-digging in Durham also afforded some obscure vegetable impressions. The coal from these plants burns with a feeble flame and a disagreeable peat-like odor. That found in trap at Farmington, Southbury, and at Rocky Hill, Hartford, ignites slowly, and burns without flame or odor: it is therefore, rather referable to anthracite than to bituminous coal. The coaly matter, occurring in seams with crystals of dolomite in marly shale at Berlin, and in the bituminous shales of Southbury, is compact bitumen. In many instances when freshly taken from the quarry it is semi-fluid, or only so much inspissated as to form what is called the elastic bitumen, or mineral-caoutchouc. It burns with a white flame and much smoke."

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* See Vol. iv, pp. 52 and 187 of this Journal.

"*Plumbago.*—A plumbago-mine was worked to some extent, seventy or eighty years ago, in the northwest corner of Ashford, on land then owned by Mr. Adonijah Backus. It had been previously opened, but at what period is not now known. At the time here mentioned however, a number of tons of plumbago were obtained. The mine was worked in the manner of a quarry, and an excavation made of considerable extent. This is now completely filled up with stones, which have been carted thither from the contiguous fields; a road also passes quite across one end of the trench. The rock of the vicinity is gneiss, analogous to that embracing the plumbago at Sturbridge, which is about six miles in a northeasterly direction from this place. And such is the conformity of this direction with that of the stratification of the gneiss, as almost to justify the opinion, that the Ashford and the Sturbridge deposits of plumbago have a connexion with each other. This suggestion is the more probable from the fact, that the gneiss rock is similar at both places, and contains scales of the mineral in question at several intermerdiate points."

A number of persons from Colchester, in 1813, from the loose materials thrown out eighty years ago, obtained in a short time a wagon-load of plumbago.

"Another depository of plumbago is in the western part of Cornwall, on a mountain nearly three hundred feet high, and situated directly upon the eastern bank of the Housatonic river. It is the property of Mr. Gideon P. Pangman. The rock is gneiss, and wherever it comes into view on its western slope, this mineral may be detected as entering more or less into its composition,—sometimes in large proportion, forming a plumbaginous gneiss. A trench has been excavated at an elevation of about one hundred and fifty feet above the river, nearly six feet wide and twenty long, into a rock containing large laminæ of plumbago."

Gems.—*Topaz* at Monroe in profusion in a vein of fluor spar—numerous crystals—some beautiful, but often large and coarse.

Sapphire at Litchfield—chrysoberyl at Haddam—emeralds and beryls at Haddam—tourmaline at Monroe, Haddam, &c. Zircon at at Haddam and Middletown—garnets in many places—agates in East Haven, Southbury, Farmington—corundum in Litchfield.

" *Soapstone.*—The rock referred to under this name in Greenwich, Stanwich, Litchfield, New Hartford, Wilton and Colebrook, is entirely composed of asbestiform tremolite, and might with great propriety be called asbestus-rock, since in some of these places it forms extensive beds. All attemps to quarry and to split it, must be attended with so much difficulty, that it can never come into competition with genuine soapstone. Rudely shaped blocks of it are used to some extent in furnaces, in the chimneys of smiths and for common chimney-backs.

" A soapstone better entitled to the name, though not of the best quality, exists in Somers, where it has been quarried for many years. The quarry is on the eastern side of Durfee mountain, about one hundred and fifty feet above its base. It occurs with talc-slate in interstratified masses in hornblendic gneiss. It abounds too much in tremolite crystals, and grains of magnetic-iron, to admit of the most valued applications of this substance as a fire-stone; besides it is injured by possessing too shistose a texture. The uses to which it has been applied are, for hearth and grave-stones, and for jambs. At present however, it is but little worked.

" The chlorite of Newtown is well adapted to the manufacture of ink-stands and similar articles, and has already been employed to some extent for this purpose. The true soapstone or steatite is found at Bartholomew's factory in Bristol, and at two places farther south, where it exists in a limited formation of hornblendic serpentine, forming coatings and veins. It possesses all the requisites for the purposes above described as pertaining to this substance, and it has already attracted the notice of tailors, who have found it possessed of the same properties as the French chalk of the shops."

The best soapstone in New England is obtained from Orford and Francistown, N. H., also near Bellows' Falls, Vermont, and from Middlefield, Mass.

" *The materials for the fabrication of bricks are every where abundant*, and of the best quality, throughout the secondary region of the State." In New Milford there is a bed of porcelain clay proceeding from the decomposition of granite, covering several acres. It forms an excellent material for small furnaces, and for lining anthracite stoves; the fire-bricks made from it are nearly equal to those of Stourbridge, England, and cost about two-thirds as much. Porcelain clay is found also in Sherman, Kent, Cornwall, Granby, &c.

The feldspar quarry, below Middletown, affords inexhaustible and excellent materials for the manufacture of porcelain. Seven hundred tons were delivered at Middletown last year, of which 600 tons were shipped to Liverpool, and 100 to the porcelain manufactory at Jersey City.

Siliceous sand of excellent quality for the manufacture of glass, is found in Middlebury.

Fire-Stones.—Quartzy graywackes, micaceous gneiss, mica-slate, and steatitic or asbestus-rocks, are often employed as fire-stones. Quartz rock and micaceous quartz rock are used for the same purpose. A rock of the latter kind used at Stafford "is arranged in laminæ of such thinness, that it requires at least fifty repetitions of them to form an inch. Each layer is completely coated with an almost unbroken film of white-mica. The rock cleaves with the utmost facility, and perfectly strait. The layers of quartz, moreover, are made up of slightly cohering, transparent grains, in consequence of which structure the rock is a very weak one, and may be broken with a slight force even in slabs of considerable thickness, and it may be cut and dressed on the edges with much more facility than the softest sandstone. It occurs at the quarry in strata nearly vertical; and is shaped into blocks two feet square on the broadest face, by sixteen inches thick. In this condition it sells for sixteen dollars per ton. The demand for the stone at present is sufficient to afford constant employment to two quarrymen. The blocks simply require to be so arranged in furnaces as to have their edges perpendicular to the surface of melted metal. Some of these fire-stones at the furnace in Stafford, after they had been subjected to this use, were observed to have undergone a semi-fusion only, even where they had been exposed to the most intense heat. The silica on the exterior of each siliceous lamina had apparently been adequate to the saturation of the earthy bases contained in the mica, leaving the centre unaffected; while the glass produced, had on the whole been sufficient to convert the stone from a friable, into a closely agglutinated mass. Those fragments and masses of the rock not adapted to use in furnaces are reduced to sand, and employed to some extent along with lime, in the preparation of a handsome finish for the walls of rooms."

Fluxes.—The minerals generally used are limestone, quartz, and fluor spar, and magnetic pyrites.

Silex combines with the bases and forms silicates as they are termed.

Quick Lime and Water Cement.—The State abounds with materials for these most useful compositions; much of the limestone is magnesian, which answers well for the purposes of the arts, and although said to be injurious as a manure, Mr. Bakewell asserts that it is only necessary to employ it in smaller quantity. In pure limestone, "the carbonate of lime is present in a proportion not lower than eighty-five per cent., the remainder consisting of magnesia, alumina, the oxides of iron and manganese, and of silica. The magnesian lime is the product of rocks in which carbonate of magnesia is associated with the carbonate of lime in a proportion, between fifteen and forty-five per cent. Hydraulic lime is derived from rocks containing between ten and thirty per cent. of clay, (a mixture of silica and alumina in nearly equal proportions.) These varieties are essentially different from each other. The two first are alike adapted to atmospheric uses; the last, as its name signifies, to subaqueous applications,—having the extraordinary property of hardening under water.

"Pure limestone as well as dolomite, is extremely scarce throughout the whole eastern half of the State. It is probable that the bed of dolomite in North Stonington may be found extending itself for a few miles, both in a northerly and southerly direction from Geer's kiln, but beyond this no indications of limestone appear except in the mica-slate of Bolton mountain. At the notch in Bolton, several thin beds of pure limestone make their appearance, and the same strata occur again nearly two miles north in the flagging-stone quarry in Vernon. The overlie of the flagging-stone here, for a thickness of thirty feet, chiefly consists of a calcareous mica-slate, in some layers sufficiently rich in carbonate of lime to be burnt for agricultural purposes, if not for the fabrication of mortar. The same stratum is no doubt continuous through the range, and in some part of it may be still richer in lime.

"The western part of the State on the other hand, is in general well supplied with the varieties of calcareous rocks, although the dolomitic kind greatly prevails. Still even within the dolomite, it is believed that extensive beds of pure limestone exist."

Stone Paints.—These are made from soapstone at Greenwich, where fifty tons were ground in 1835. Serpentine and sulphate of barytes are also used.

Architectural Materials.—"The building stone of Connecticut, both ornamental and common, constitute one of the most valuable resources of the State, whether considered as affording a supply to its own wants, or materials for exportation. The principal kinds at present in use are granite (the term being used in its widest sense,) gneiss, sandstone, marble, sandstone-conglomerate and trap. The two last mentioned are employed only as a common building material.

"The ornamental granite found in the State presents numerous varieties; in treating of which, it will be convenient to refer them to several general types under distinct names. 1. *Gray granite.* 2. *White granite.* 3. *Flesh colored granite.* 4. *Red granite.* 5. *Epidotic granite.* 6. *Porphyritic granite. Green porphyritic granite. Gray porphyritic granite.* 7. *Chloritic granite.* 8. *Sienitic granite.* The gray granite is the most abundant and the most useful. A beautiful granite of this kind is wrought at Waterford.

"Mine-hill in Roxbury has been much resorted to, for a more shistose and lighter colored granite (strictly gneiss) than that just described. It is easily obtained in very large tabular blocks, and might with as much propriety be embraced under flagging stones, as it is employed for paving as well as for building stone. Its leading use, however, is for underpinning and for stepping stones. At present, it employs but two or three hands. A similar use is made of the Willimantic quarry and of several others. The quarries in Greenwich afford several light colored varieties of gray granite, but are wrought almost exclusively as a common building stone, and are taken in large quantities to New York city.

"Other localities deserving to be indicated as likely to furnish valuable deposits of this stone, are the following: Stonington, Groton, the country between Norwalk and Darien, North Fairfield, north part of Wilton, region in vicinity of Torringford and Wolcottville, Winsted, western part of New Milford, Canada village (Goshen,) Warren, Marlborough, and Voluntown.

"There is but one quarry of the white granite which is wrought at present. It is in Plymouth, near the woolen manufactory of Mr. Henry Terry. The bed is extensive, forming apparently the western side of a hill, which is above a mile long, though concealed to a considerable extent by soil. It is the most beautiful granite in the State; nor is it surpassed in whiteness and transparency of material by any granite in the country. The distance from water-communication alone prevents it from being a source of great value to the proprietors."

The number of quarries of beautiful granite is so great that we cannot quote them, but must refer to the original report.

White marble is extensively quarried for architecture at New Preston; the average yield of the quarries here is seven to eight thousand dollars for the rough stone, and nearly as much more for preparing it in the neighboring shops.

Sandstone is more extensively used than all other materials derived from rocks. This rock is often soft when taken from the ground but hardens in the air, and its nearly horizontal stratification make it very easy to remove it from the quarry.

"It is unnecessary to enter into details respecting the sandstone quarries of the Connecticut valley. There is scarcely a neighborhood not affording this valuable material in sufficient quantity for its own demand; while the great quarry at Chatham which employs two hundred men, furnishes blocks to all the maritime cities in the United States. Its very great facilities for supplying, added to its contiguity to the river, give it an advantage in shipping this stone, which it is doubtful whether any other quarry in the country will ever be found to possess. As a very peculiar variety on account of its color, the quarry at Wapping (East Windsor,) is entitled to mention. The sandstone here is of a bright and uniform brick-red.

"The most interesting deposit of sandstone for ornamental architecture yet developed in the State, is situated in North Haven, at the east end of Mount Carmel, on the middle road between New Haven and Hartford.

"Upon the common building materials of the State it may be remarked, that we have but few rocks unfit for cheap and ordinary structures. If we except mica-slate, argillite, talcose and chlorite-slate, the more fissile shales and marly slate of the secondary, all the others are more or less employed. Trap is most used in the valley of the Connecticut, and is not surpassed for strength and inalterability by any other stone. It is frequently quarried without the aid of gunpowder, the seams of the rock presenting natural divisions.

"Common building stone is quarried at several places in the State, for exportation. It is generally spoken of as foundation-stone, or as fort or block-stone. Large quantities are shipped from the quarries situated immediately on the banks of the Connecticut and the Thames, to be employed in New York and in the public works along the coast. The quarries on the east side of the river at Haddam are particularly engaged in this business, and employ forty or fifty men. LORD's quarry in Lyme is well located for affording this kind of stone. In 1832 and 1833 it employed upwards of thirty hands, being then engaged in furnishing stone for the construction of canal-locks in New Jersey. The stone for the foundation-work of the Merchants' Exchange in New York was supplied during the last season from this quarry.

"CHAPMAN's quarry of granitic-gneiss on the east side of the Thames in Groton, a few miles above New London, is also extensively engaged in furnishing block-stone. Twelve hands were employed here last summer. The stone is quarried at an expense of twelve cents the foot, and its freight to New York costs from six to eight cents. A quarry for similar stone on the opposite of the river in Waterford, was worked five years ago to furnish stone for the public works at Pensacola. Common building stone is extensively quarried also at Greenwich, both for the construction of public works and for ordinary building in the city of New York."

The verd antique marble of Milford is a beautiful ornamental stone of inexhaustible variety. It is not fitted for outside decoration, because its fine colors become dull in the weather, but within doors they are permanent. It is true that all the marble obtained at Milford is not verd antique; but we cannot agree to confine it within the narrow limits drawn by Mr. Shepard, as we are sure it is not so limited in the fine tables, vases, &c. seen in Europe, and sometimes in this country.

Stones for Flagging, Tiling, &c.—"The flagging-stone of the State is referable to the following rocks,—gneiss, micaceous quartz-rock, mica-slate, and sandstone slate; and together constitute a resource fully equal to its building-materials. The quarries of gneiss on the Connecticut river rank very high in importance, not only on account of the intrinsic excellence they possess, but from their proximity to the river. They are situated at Middletown, at Chatham, at Haddam on both sides of the river, and also at Chester, Hadlyme and Essex; and they are remarkable for the uniformity of their character in every place where they are explored in these towns, as well as further southwest in Madison, where extensive quarries also exist. It is difficult to ascertain the number of hands employed in quarrying this rock; but from such facts as could be collected, it is believed that they ordinarily fall but little below five hundred. The properties of the gneiss are in a measure peculiar: at least, no rock precisely resembles it in any part of the State. Its leading peculiarities depend upon its black mica and transparent grains of albite. These are arranged in thin, strait, and parallel layers, giving to surfaces produced by cross-fracture a banded appearance of black and gray; while the surfaces resulting from cleavage are almost black. Both the mica and the albite possess high degrees of lustre, which impart to the rock a very brilliant effect,—rendering fresh slabs of it almost insupportable to the eyes, in a strong light of the sun. The cleavages do not take place with the greatest freedom, and can rarely be effected, so as to divide the rock into slabs of less than six inches in thickness.* They are particularly prone to occur where the mica is most abundant, and this in general is contiguous to those layers of albite which are made up of larger individuals than the average size. The rock contains very little quartz. Hornblende is occasionally present, which is of a black color, highly crystalline, and brilliant in its lustre. The process of quarrying appears to be conducted with the greater facility, from the highly inclined position of the strata. Slabs of any dimensions are easily procured. Its great use seems to be for flag and curb-stones, though it is also employed extensively in the construction of wharves, bridges, breakwaters and fortifications, for which purposes its strength and inalterability render it very desirable. It is likewise used for underpinning stones, and for posts to gateways and fences which in some instances are covered by wood. As it is a material of great importance in paving, it is sought for in all the large cities, being extensively used in Boston, New York and Philadelphia, and of late has been introduced into Charleston and New Orleans, where it is likely to prove highly important in the paving improvements recently commenced in these cities. It may well be doubted whether any material will be brought to light in the country, better adapted either in quality or local situation than the gneiss of the Connecticut river, for satisfying these demands.

"In the northwestern part of Lebanon, a little east of what is called Hearth-stone hill, a very valuable flagging is quarried. It consists of a feldspathic gneiss. It is very thinly stratified, strait and easily separable. Much of it consists almost wholly of feldspar. Flags are quarried here of great size and any desirable degree of thinness; and although the transportation by land to market (to Norwich) is above fifteen miles, they are yet afforded so low as to compete with the Bolton stone."

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* Many of the flagging stones sold in New Haven are not more than one, two or three inches thick, and come, we believe, from Haddam.—Ed.

"Next in importance to the gneiss, the mica-slate of Bolton mountain deserves to be noticed as a flagging-stone. No material of this species has yet been discovered in the United States or elsewhere, capable of being compared with this invaluable stone. Slabs five feet by eight, and even larger, are furnished by these quarries, whose surfaces are as true and smooth, as any granite or sandstone could be rendered by the nicest process of dressing, and yet with a thickness not above six or eight inches. The rock derives its color from the mica, which is of a silver gray. It is so abundant that its cleavage surfaces exhibit no other mineral, and its lustre is no less brilliant than that of the Haddam gneiss. The stratification of the rock is extremely uniform and always thin, sometimes apparently consisting of upwards of an hundred thicknesses of mica in one inch. The layers interposed between the mica in one variety of the rock, consist of an aggregate of grains of quartz, feldspar and garnet; but each so small as to require a microscope for detection. The use for which this stone is especially fitted is for side-walks, market-houses, cellars, and foot-paths generally about houses, as well as for water-gutters. Its strength is inadequate to the support of carriage-wheels. It should, therefore, in the paving of streets, be employed along with the Connecticut river gneiss, whose firmness admirably fits it for foot-paths across streets and for curb-stones. The quarries extend for two miles along the Bolton mountain. The stratum which affords the flagging-stone is from fifteen to twenty feet in thickness; and of this the upper part, to the depth of six feet is of inferior value, affording only a small proportion of flagging-stone. Above this stratum is an overlie of nearly forty feet, of dark, gray micaceous limestone or calcareous mica-slate.

"The strata dip westerly from 25 to 30°. The thin stratum between the garnetiferous mica-slate and flagging-variety is called the diamond-reef by the workmen, on account of the rhomboidal fragments into which it separates. The labor of quarrying the flagging-stone is very considerable. The superincumbent strata require to be removed as fast as the workmen advance in the removal of the flagging-stone. Thus, they are obliged to reject more than two-thirds of the stone in working the quarry; this stone is sold in Hartford at from ten to twelve cents the square foot."

"The quarries of Killingly have but recently been opened; and although highly promising in their character, are comparatively but little known to the public at large. The stone is altogether peculiar in its character. It is the micaceous quartz-rock, consisting almost exclusively of the species quartz. The mica present is nearly undistinguishable, and would quite escape ordinary observation but for its hair-brown color. It is most obvious on the cleavage-surfaces, where it is seen collected together into clouded patches; but so small is its quantity on the whole, that it seems almost inadequate to account for the free and strait cleavages by which the rock separates, and yet no other cause can be adduced for their production. The mica sometimes has a yellowish tinge, in which case we have a rock so exactly identical in structure and appearance with the avanturine of Spain that samples of it are well worthy of being submitted to the wheel of the lapidary. The cleavages occur at distances, of from half an inch to four and six inches apart, and seem perfectly parallel often for ten or fifteen feet in each direction. The surfaces of the slabs are as smooth and even, as those of the best moulded tiles. In strength, it is not inferior to any other flagging-stone, if we except perhaps the hornblende-slate. It is not liable to disintegration from exposure to the weather, or from immersion in water. In these respects it surpasses in value the more micaceous slates. Judging from weather-beaten masses of the rock, it grows whiter on exposure; an effect resulting from the loss of the brown mica, which is more abundant on the cleavage surfaces than through the general mass of the stone.

"The uses to which this flagging-stone may be applied are numerous, and many of them quite new. As a paving for side-walks it must be pre-eminently valuable, not only on account of the size of the slabs and their smoothness, but from the hardness of the material. The friction to which it will be subjected in this situation cannot it would seem, make the slightest impression upon it; for its hardness is superior to that of the firmest and most imperishable granite. For this reason, flag-stones from this rock which have been long in use will not require to be roughened up with the chisel, as is the case with some of the softer mica-slates. In the paving of door-yards, warehouses and cellars, its value is equally obvious. It must surpass all other materials also, for lining drains, water-sluices and canals; and it is even possible that it may prove useful in the roofing of small buildings. It is a fortunate circumstance that the supply of this stone is unlimited, and that it is favorably situated in the quarries for working. Excellent stone, essentially of this kind, has been obtained at various places on one and the same range, for several miles in extent. The most important opening made at present however, is that of BOLLES and TYLER. It is about three hundred and fifty feet long, fifty feet wide (of uncovered rock), and twenty-five above a narrow valley separating it from a higher ledge on the west. The direction of the strata is north by east, and the dip northwesterly 40 or 45°. The rock is almost without cross-seams, which renders the quarrying somewhat difficult. Those which do occur, are from ten to thirty feet apart, and have a direction northwest by west. The rock is singularly striated in the direction of the edges of stratification. The average thickness of the layers is between two and four inches."

Slate for tiling exists in the Woodbridge hills near New Haven, and was formerly quarried; it is firm and does not exfoliate, and is easily pierced by a nail.

Excellent paving stones are found on the sea shores—often inland and upon the river banks, and the trap regions abound with them.

The mineral springs of Connecticut are almost universally mild chalybeates—carbonate of iron being suspended by carbonic acid gas. "The most important are those of Stafford. Ample accommodations here exist for invalids, and during the warm season they are a favorite resort. No perceptible escape of gas from the water is observed. The sides of the reservoir are lined with a thick flocculent precipitate of the oxide of iron, occasioned by the decomposition of the carbonate of iron from the access of air." It is a mistake that some of these springs are sulphureous: from examination on the spot we know that they do not tarnish muriate of bismuth or acetate of lead.*

The soils of Connecticut are such as might be expected from the nature of its rocks, and are generally deficient in the important ingredient of lime. Lime may doubtless be used with advantage, and Mr. Shepard informs us that Mr. Platt, of Danbury, is about preparing it for farmers. We much doubt however the validity of the caution as to the use of the magnesian limestone, provided the quantity be diminished or be mixed with other manuring materials.

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* Editor.

The rich marls of the Chesapeake and its confluent rivers are now beginning to be introduced into the port of New Haven as a manure to be transported by the Farmington canal into the interior. It remains to be seen whether the price and efficacy will sustain the undertaking. If this material should enable us to restore the culture of wheat it would be a very important advantage.*

The Scientific Report scarcely admits of analysis or condensation. It presents a rich variety of minerals—natives of the small territory of Connecticut, scarcely one hundred miles by sixty. Its fluor spar, feldspar, andalusite, chrysoberyl, topaz, emerald, tungsten, columbite, native copper, &c. are among its mineral attractions, and Mr. Shepard has well set forth the claims of the State to the consideration of mineralogists. No man is better acquainted with American local mineralogy. We cannot however but regret that he has in his scientific report rendered the dryness and repulsiveness of mineralogical language doubly difficult and disagreeable, by introducing the uncouth names of the school of Vienna.

What advantage is gained by extending the term baryte, or mica, or pyrites, heretofore perfectly definite, to many substances besides those to which they were formerly applied with so much felicity? and what advantage do we gain by such words as Atelene-Picrosmine for Serpentine, Kouphone-Spar for Prehnite, Eruthrone-Ore for Sphene, Malacone-Metal for Bismuth and Copper, Sclerone-Metal for Native-Iron, Eruthleucone-Pyrites for Copper-Nickel and Mispickel, Polypoione-Glance for Galena, &c. &c.? Happily, however, his descriptive catalogue, in which he has judiciously placed the old familiar names in front, and ordered these foreign auxiliaries into the rear—especially when aided by the specimens themselves, well selected, arranged, and preserved as they are, will redeem the effect of this strange nomenclature, and his work will stand as a lasting and honorable monument to his industry, skill, science, zeal and fidelity in accomplishing an arduous and responsible labor, for which he deserves the gratitude, not only of all the citizens of Connecticut, but of all lovers of science and of sound improvement in the great interests of society; and Gov. Edwards will be remembered with honor as the patron of this survey, when the party distinctions of the times, and all whose ephemeral fame depends upon them, shall have passed into eternal oblivion.

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* We are glad to observe during a recent tour, that there are numerous fine fields of wheat in New Hampshire, and we are assured there are many more in Maine.—(*September* 21, 1837.)—Ed.

Art. XVII.—*On the Shooting Stars of August 9th and 10th, 1837; and on the Probability of the Annual Occurrence of a Meteoric Shower in August;* by Edward C. Herrick.

The investigation of the causes of the luminous meteors called *shooting stars*, is a matter of great and increasing interest; and it is therefore important to collect and place on record, every particular of consequence regarding the unusual display of these bodies witnessed on the night of Wednesday, August 9th, 1837. The few facts here given are in addition to those stated in the interesting communication of Mr. Schaeffer, (p. 133 of this No.,) in which article are contained the only definite observations of this phenomenon, which have come to my knowledge.

Between 9 and 10 P. M. of the evening above mentioned, I noticed in the northeastern quarter of the heavens, (that being the only portion visible at my station,) from twelve to fifteen shooting stars of uncommon brilliancy, most of which left trains of considerable extent. The moon was about two hours high in the west at the time, and doubtless concealed some of inferior lustre. No attempt was made to ascertain the radiating point of the meteors, but I noticed that many of them proceeded in a southwestern direction from a region in the northeast. My observations ceased at ten o'clock. From persons who were abroad after midnight, it appears that from about 1 A. M. until the morning light, the meteors were numerous and brilliant, and attracted the notice of many who commonly give no heed to celestial appearances. I have no data for estimating the number seen during the night; but there can be no doubt that it far exceeded the amount commonly visible during the like period of time. It is no less doubtful that the display was greatly inferior to the ever-memorable spectacle of the night of the 12th of November, 1833.

Over what extent of country this phenomenon was seen, we have not at present the means of determining. The whole amount of information concerning it which has hitherto reached us from a distance is very limited. It is earnestly to be desired that all who have in their possession any accurate observations upon it should give them to the public. It was seen as far south as Macon, Ga., (lat. 32° 52′ N., long. 73° 44′ W.,) as appears by the following article, quoted from the *Messenger* of the 17th August, through the (New Haven) Daily Herald of September 4th.

"*Shooting Stars.*—On Wednesday night the 9th, a considerable display of this kind took place in the heavens. For several hours from one to a dozen could be constantly seen shooting towards every point of the compass at various angles, and often horizontally. In many cases they were very near the earth, representing a mere spark, and shooting with great velocity, and again they were in appearance equal to stars of the largest magnitude, leaving a long train after them, which was sometimes visible for two minutes. Most of them were of a yellowish or flame color, but we noticed one of the very largest size of a deep red, which moved off slowly and majestically with a brilliant train. We noticed them from 1 to 3 o'clock, but we are told they commenced early in the night."

On the probable periodicity of the meteoric shower of August 9th and 10th.

In Prof. Loomis's article on shooting stars, (vol. xxviii, p. 95, of this Journal,) in which he gives an abstract of observations made in Germany from April to Oct. 1823, by Prof. Brandes and his associates, it is stated that on August 10th, 1823, "one hundred and forty shooting stars were noted in less than two hours," besides many which were of necessity left unrecorded. The near coincidence of this date with that of the display of this year at once suggested to me the possibility of its periodical nature, and incited me to an examination of such sources of information as could be readily obtained. I have had neither the time nor the means necessary for making a very extensive exploration, but as the facts which even this hasty search has brought to light are of much interest, I think best to make them public without delay. Those who have access to extensive libraries will I trust, push the inquiry farther.*

These facts appear to me sufficient to render highly probable the *periodical occurrence of an unusually large number of shooting stars on or about the 9th of August.* The particulars of the evidence are the following.

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* Many works which would probably throw light on the subject are beyond my reach; e. g. various volumes of Gilbert's Annalen der Physik; Quetelet in Bib. Univ. de Genève, Mars, 1837.—Analyst, August, 1834. Dodsley's Annual Register for 1783, p. 214, speaking of two meteorites seen August 18th, 1783, says, "The phenomenon which appeared in 1716, and continued from 8 P. M. till 3 in the morning was like the present, not local, &c." Was this a shower of shooting stars?

1. The observations of Prof. Brandes above mentioned.

2. In the meteorological observations appended to the "Report of the Regents of the University of the State of N. York, made March, 1837," is the following entry, p. 169. "August 9, 1836, meteors frequent during the night, Bridgewater, N. Y." No other like entry occurs throughout the year.*

3. "During the extreme heat which introduced the pestilence of the last summer, 1798, about the 9th of August, the small meteors or falling stars were incredibly numerous for several nights. They almost all shot from the northeast to the southwest, and succeeded each other so rapidly as to keep the eye of a curious spectator almost constantly engaged." *Dr. N. Webster's "Brief History of Epidemic and Pestilential Diseases,"* &c. (2 vols. 8vo. Hartford, 1799,) vol. ii. p. 89. It will be noticed that these meteors coincided very nearly in direction with those of 1837.

4. Mr. Caleb Gannett in a Historical Register of the Aurora Borealis, contained in the Memoirs of the American Academy, vol. i. (Boston, 1785, 4to.) p. 327, states that on the night of August 8th, 1781, "Meteors appeared in great numbers, shooting, in general, from N. W. to S. E."

5. An unusual display appears to have been witnessed in Worcestershire, (England,) August 10th, 1833, but the notices of the event, within my reach, are so scanty, that the case cannot at present be considered a very strong one. Mr. W. B. Clarke, in a meteorological summary for 1833, (Loudon's Mag. Nat. Hist. May, 1837, p. 232,) reports—"1833, August 10th. Falling stars and meteors in Worcestershire 10 to 12 P. M.," and again (idem. vol. vii, 1834, p. 386,) in speaking of the meteors of November, 1833, he asks, "Why may we not suppose that the meteors of precisely

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* P. S. Since this article was sent to press, I have received the following important additional facts concerning this case, from Prof. B. F. Joslin, to whom I had written for information. He has kindly furnished me with a transcript of his meteorological record for that evening, viz. Tuesday, August 9th, 1836. I regret that there is room here only for his results. "Combining the above observations, I conclude that during most of the evening, at least when observations were made, late or early, the shooting stars fell in the observed and unobserved quarters of the sky at the rate of about *one hundred and fifty per hour;* that those which did not leave trains were small; that the trains were real; that the long trains were all small; that the large brilliant trains were all short; that all the meteors descended; and that they appeared at a time when an aurora might have been expected had not the barometer become stationary; yet it had been rising, and the thermometer falling." The observations were made at Schenectady, N. Y.

similar character seen on August 10th, 1833, in Worcestershire, at 10 to 12 P. M., were cometic fragments?" He refers to Mr. Lees's paper on the Aurora in the Analyst, No. 1, p. 33, for August, 1834, which probably contains the particulars.*

6. The next extract may perhaps have no bearing on the point in question. It seems to be however proper to quote it, as it may lead to further disclosures from other witnesses. It is found in the meteorological observations for 1809, contained in the Edinburgh Annual Register for 1809, vol. ii. part 2, p. 508.

> "On the 10th of August, (1809,) during the night, there was a good deal of thunder, lightening and rain at London. During this storm, about half past one o'clock in the morning, the whole of the sky appeared to be covered with one unbroken mass of black pitchy cloud, in which no break was visible, even during the vivid flashes of lightening which seemed to come from an inferior region of the sky. Over, or rather below this dark surface were spread light and flocky clouds, broken into large fleeces, and apparently luminous throughout. They seemed full of little dazzling and dancing specks of light that sometimes shone as stars through a misty cloud. Some of those increased gradually, and then died away; but one of them increased to such a degree as to equal Venus in size and lustre. This luminous body moved with considerable rapidity round the edge of that mass in which it appeared. Another brilliant meteor of the same kind appeared in a similar cloud at a considerable distance. It was distinctly observed by M. Staveley, to whom we are indebted for an account of the preceding phenomena, that no lightening broke from the luminous clouds, but they emitted a light of a pale phosphoric color."

7. The following notice, although brief and indefinite, seems to deserve a place here, as it may when fully developed prove important. It is copied from an account, (contained in the London Athenæum of March 25, 1837,) of M. Von Hammer's communication on falling stars, to the French Academy of Sciences. "In the history of Cairo, by Soyorite, we find the following, 'In this year, (1029 of our era,) in the month of Redjeb, (August,) many stars fell with a great noise and brilliant light.'"

The very interesting discovery made by Prof. Olmsted of the periodicity of the meteoric shower of November, has invested these bodies with an importance unthought of in former times. "A new planetary world," says M. Arago, "is beginning to reveal itself to us." Before the final settlement of a theory for the phenomenon, extensive and exact observations, continued during all the favorable nights of the year, and for many years, are greatly needed. Such observations we can scarcely expect to obtain; yet much might be accomplished if the watch at the various military stations throughout the world and on board national vessels could be induced to lend their aid. The connection between these meteors and the *Zodiacal Light* which Prof. Olmsted has suggested, renders it also highly important that this appearance should be observed with the most careful attention.

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* The following fact came to my notice too late for insertion in the text. Mr. J. P. Espy, in Jour. of Franklin Inst. vol. xv. 1835, p. 234, has recorded letters from Messrs. S. C. Walker, W. H. C. Riggs and John Black, which state that on the night of 7th–8th August, 1833, "numerous luminous bodies, on all sides, falling quite thick," were observed for a short time at Philadelphia. They were not in all points like *shooting stars*, but resembled them more nearly than they did any thing else. Further consideration of this case is unavoidably deferred.

New Haven, Conn.

MISCELLANIES.

DOMESTIC AND FOREIGN.

Bibliographical Notices.

1. ***Boston Journal of Natural History, containing papers and communications read to the Boston Society of Natural History.*** Part I. No. 4. Boston. Hilliard, Gray & Co. 1837.—A notice of an earlier part of the transactions will be found in Vol. 31, p. 185, and in our last number we republished the annual report of the Society. It gives us pleasure to announce the appearance of the fourth number of their Journal, completing the first part of the first volume. Mr. Say's Descriptions of New Species of North American Hymenoptera, &c. is completed. Art. 18. Description of a new species of the genus Hydrargyra; with some additions to the catalogue of the fishes of Massachusetts in Prof. Hitchcock's "Report." By D. Humphreys Storer, M. D. Art. 19. Remarks on the Positions assumed by George Ord, Esq. in relation to the Cow Black Bird, (*Icterus Agripennis*) in Loudon's Magazine for February, 1836. By Mr. Thos. M. Brewer. Art. 20. Some additions to the catalogue of the Birds of Massachusetts in Prof. Hitchcock's "Report." By Mr. Thos. M. Brewer. Art. 21. Descriptions of a new species of the genus Marginella, (Lam.) with some observations on the same. By Capt. Joseph Couthouy. Art. 22. Anatomical de-

scription of the Galapagos Tortoise. By J. S. B. Jackson, M. D. Art. 23. Description of a new species of the genus Gasterosteus. By D. Humphreys Storer, M. D. Art. 24. Description of a new species of Marginella. By D. Humphreys Storer, M. D. Art. 25. A Monograph of the Helices inhabiting the United States. By Amos Binney, M. D. Catalogue of the Library—Donors to the Library—Donations—Index. These papers are all valuable and of a highly scientific character. Mr. Binney's Monograph of the Helices is peculiarly interesting to American conchologists, as clearing up much uncertainty that hung over many of the species—restoring them in some cases to their original discoverer, and presenting us the whole of this natural family at one view. All the other papers are interesting in this way, and will no doubt receive the attention they deserve.

2. *Catalogue of the Library of the Academy of Natural Sciences of Philadelphia.* Phil. J. Dobson. 1837. 8vo. pp. 300.—This is an important document, inasmuch as the library is the largest and the most important on its own peculiar branches in this country. What is of more interest, however, is that the whole library, with the exception of five hundred and fifty eight volumes, is the result of the munificence of one individual—the venerable WM. MACLURE, now residing in Mexico, the pioneer of American Geology, and ever the most efficient patron and still a laborer in the fields of science. It has been owing chiefly to his efficient aid that the library of the Philadelphia Academy has been formed, while its members have labored ably and faithfully, and the result of their labors may be seen in the valuable Journal of the transactions of the society noticed frequently in our pages.

It appears from the report prefixed to this catalogue that the library contains exclusive of tracts, six thousand eight hundred and ninety volumes, which may be classed according to size in the following manner:

Folio, - - - -	674
Quarto, - - - -	1,595
Octavo, - - - -	3,723
Duodecimo, &c. - - -	898
	6,890

Besides these there are four hundred and thirty five separate maps and charts. Of the above, Mr. Maclure has presented the following:

Folio,	612
Quarto,	1,131
Octavo,	2,699
Duodecimo, &c.	790
	5,232

The report, speaking of the donations of Mr. Maclure, says—"It is with no ordinary pleasure and gratitude that the committee take this occasion to record the fact, that of the above volumes no less than five thousand two hundred and thirty two have been derived from the munificence of a single individnal, William Maclure, Esq., President of our institution. To these are added nearly all the separate maps and charts."

The catalogue is divided under heads according to subjects, and these are arranged alphabetically by the names of the authors, and at the end is a general index of the whole. In a library for reference the value of the arrangement must of course depend on the facility with which that reference can be made; this, in the present instance, the committee in their report assure us is very great. This library is not exclusively confined to natural history, but embraces books on many other departments of science and useful knowledge.

3. *Lyell's Geology. First American from the Fifth and last London Edition*, 2 vols. 8vo. Philadelphia. James Kay, Jun. & Brother. 1837.—For our opinion of this admirable work we would refer to Vol. xxix. p. 358, of this Journal. Since those remarks were made, a fifth edition has appeared in London with various additions and improvements, and from this last edition the one before us has been published with all the cuts. The style and mechanical execution of the American edition are creditable to its publishers; the four duodecimos of the author are comprised in two handsome octavos of about five hundred and fifty pages each. Few American republications of English scientific books, so far as we have seen, will bear a very close comparison with the originals; particularly in the paper, engravings and cuts. In some instances we are sorry to say, these republications have done little credit to our character and the state of our arts; cheapness and an extensive sale have too often

been the primary considerations. But we would not be understood as applying these remarks to the work before us; we rejoice that the American scientific public have this unequalled work placed in their hands in so neat a form, and at the same time at a price not beyond their means. We trust the enterprising publishers may find sufficient encouragement to repay them for their exertions; while we could still more earnestly wish that the overtures for a reciprocal recognition of the rights of literary property on both sides of the Atlantic, which were made by numerous English authors during the last session of Congress, may be promptly accepted both for the protection of authors and the encouragement of all good learning.

4. *Flora Cestrica. An attempt to enumerate and describe the Flowering and Filicoid Plants of Chester County, in the State of Pennsylvania;* by Wm. Darlington, M. D. 2d edition. West Chester, Penn. 1837. 8vo.—The author of the volume before us has been long and favorably known to the cultivators of botanical science in this country; and valuable papers from his pen have at various times appeared in the pages of this Journal. That the present has been a work of great labor no one after glancing at its pages can doubt; and many years have been occupied in its arrangement and completion. During its progress the author has held correspondence and exchanges with all our most distinguished men in this science, and with not a few abroad. The arrangement is according to Linnæus, though the author seems to be aware of the value and importance of the *natural method* of De Candolle and others. Speaking of this subject in his preface, he says: "An apology will doubtless be expected from me for still adhering to the *Linnæan arrangement* when the modern botanical world have so generally abandoned it for the *natural method.* I am fully conscious of the old fashioned garb in which this work is arranged, and have a thorough conviction of the value and importance of studying plants according to their natural affinities; but observing that the natural method is yet kept as it were in a continual state of fermentation, by the labors and researches of the great masters in science, and feeling my inability to co-operate or aid in adjusting its details, I thought it most advisable in the present attempt, to adhere mainly to the Linnæan classification." The number of plants described by Dr. Darlington in this local Flora, is 1073—comprising 128 of Lindley's natural orders=482 genera.

Of these species there are cultivated,	92	
Introduced and naturalized, about	138	
		230
Indigenous, - - - - - -		843
Total,		1,073

We could wish to see more of these local Floras from botanists in various parts of this country; it is a subject which is commanding great attention abroad, and as a means of determining the geographical distribution and extent of plants, aside from many other advantages, they are of high importance. This volume is accompanied by a map of Chester County, colored according to the geological structure of the country; this is an idea of importance in reference to the local distribution of plants as affected by soil and other geological causes.

5. *Animal Magnetism.*—Mr. Thomas C. Hartshorn, of Providence, R. I., has translated the treatise of J. P. F. Deleuze, on animal magnetism; and appended notes referring to cases in this country.

6. *General Species and Iconography of Recent Shells, comprising the Massena Museum, the collection of Lamarck, the collection of the Museum of Natural History, and the recent discoveries of Travellers;* by L. C. Kiener, Curator of the collections of Prince Massena, member of the Nat. Hist. Soc. of France, Attaché to the Museum of Natural History of Paris, &c. &c. *Translated from the French,* by D. Humphreys Storer, M. D. Boston. Wm. D. Ticknor. 1837. No. 1, 8vo.—By the kindness of the publisher, we have early received a copy of this valuable translation of Kiener's magnificent work. The plan is the most extensive of any which has yet appeared on the important subject of Conchology, and when completed it will fill a wide gap which has hitherto existed in Conchological literature. It will be nothing less than an accurate and lucid description of every species in every genus, so far as they have fallen under the author's observation in the extensive collections of which he has the charge, or to which he has access. Hitherto we have had no translation of the description of *species* either from Lamarck or from Blainville. It is the object of Dr. Storer to give us the whole text of Kiener as fast as it appears,

in numbers containing about one hundred and fifty pages each, and extending to sixteen numbers, which will make eight volumes of three hundred pages each, at $3 a volume. The cost of the *original* work to subscribers in this country will be about $187; of the translation, (which is of course without the plates,) about $24. Speaking of the French edition, the translator says: "The high price is of course dependent on the matchless plates, but independent of these it remains a *chef d'œuvre:* The descriptions are simple, accurate, and exceedingly perfect. The student is able to distinguish at once the object of his research; and however delightful it may be to possess the illustrations he can do without them." We trust the publisher and the translator may both be gratified, and Conchological science advanced, by a list of subscribers to this important work sufficiently extensive to warrant the undertaking. The first number contains the genera *Buccinum*, (of which one hundred and one species are described,) Dolium, Tornatella, Pyramidella, Thracia, and Harpa. The mechanical execution of the work is very superior, and worthy of the reputation of the city from which it emanates.

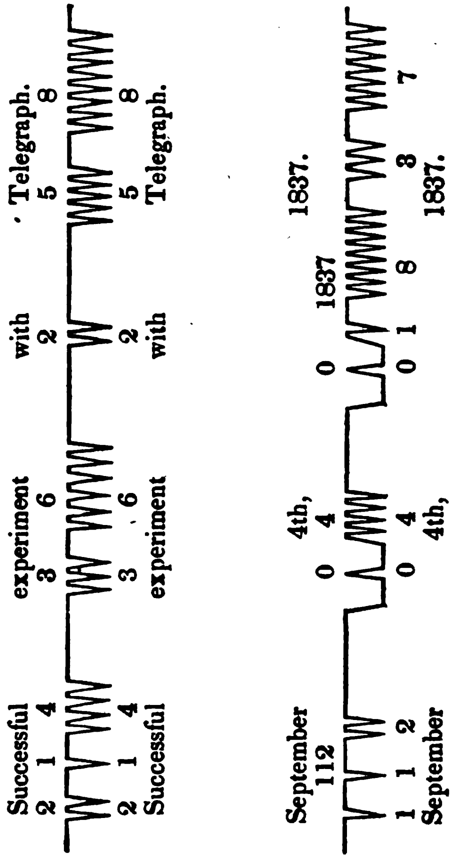
SCIENTIFIC INTELLIGENCE.

1. *Morse's Electro-Magnetic Telegraph.*—While a contest is waging in several countries of Europe—in England, Scotland, France and Germany, for the discovery and invention of the Electric Telegraph, it may not be amiss to state, that America also claims to be an independent discoverer and claimant for priority in the invention. The dates, the names of the inventors, and other circumstances will doubtless ere long be published, and then the world can judge between the conflicting parties. In the mean time it is well ascertained, that Prof. Morse, of the New York City University, conceived and planned, five years ago, an electric Telegraph, while on his passage home from France, and immediately on his landing, he commenced the machinery. Early last spring, *in April*, the general features of his plan were very extensively published in the newspapers, and very lately, *in August*, we learn that several telegraphs on the basis of electricity are in various stages of progress in Europe.

The distinguishing features of Prof. Morse's telegraph are a *Register*, which permanently records in characters easily legible the fullest communication, and the use of but *one wire* as a conductor; although for greater convenience of communicating at all times, and of having a whole circuit at command from each extremity of the line he will use four wires.

On Sept. 2d, Prof. Morse tried an experiment with a circuit of copper wire one thousand seven hundred feet in length, and of the minimum size of No. 18 wire. The record of the Register was sufficiently perfect to demonstrate the practicability of the plan. On the 4th of September some slight changes were made in the machinery, when the Register recorded perfectly the following signs:

Specimen of Telegraphic writing made by means of electricity at the distance of one third of a mile.



The *words* in the diagram were the intelligence transmitted.

The *numbers*, (in this instance arbitrary,) are the numbers of the words in a Telegraphic dictionary.

The *points* are the markings of the Register, each point being marked every time the electric fluid passes.

The Register marks but one kind of mark, to wit, (V). This can be varied two ways. By intervals thus (V VV VVV) signifying one, two, three, &c., and by reversing thus (Λ); examples of both these varieties are seen in the diagram.

The single numbers are separated by *short*, and the whole numbers by *long intervals*.

To illustrate by the diagram, the word "successful" is first found in the dictionary, and its telegraphic number 214 is set up in a species of type prepared for the purpose, and so of the other words. The types then operate upon the machinery and serve to regulate the times and intervals of the passages of electricity. Each passage of the fluid causes a pencil at the extremity of the wire to mark the points as in the diagram.

To read the marks; count the points at the bottom of each line. It will be perceived that two points come first, separated by a *short* interval from the next point. Set 2 beneath it. Then comes one point likewise separated by a *short* interval. Set 1 beneath it. Then come four points. Set 4 beneath it. But the interval in this case is a *long* interval, consequently the three numbers comprise the whole number 214.

So proceed with the rest until the numbers are all set down. Then by referring to the Telegraphic Dictionary, the words corresponding to the numbers are found, and the communication read. Thus it will be seen that by means of the changes upon *ten* characters, all words can be transmitted. But there are *two points* reversed in the lower line. These are the *eleventh* character, placed before a number to signify that it is to be read as a *number*, and not as the representative of a word.

Since the 4th of September, one thousand feet more of wire No. 23 have been added, making in all two thousand seven hundred feet—more than half a mile of a reduced size of wire; the Register still recorded accurately.

Arrangements have been made for establishing a circuit of several miles, and for constructing new and accurate machinery. Prof. Gale, of the New York City University is engaged with Prof. Morse in making some interesting experiments connected with this invention, and to test the effect of length of wire on the magnetizing influence of voltaic electricity.

2. *Notice of a Revolving Electro-Magnetic Instrument, by* Dr. Benjamin Rush McConnell.*

Mauch Chunk, Pennsylvania, June 26, 1837.

Prof. Silliman.—*Dear Sir*—Up to this date, I had entertained the hope of having ready for the ensuing number of the "Journal of Science," a digested series of "electro-magnetic experiments," the results of some inquiry involving something of novelty at least, if not of much interest. The pressure of professional duty, however, as colliery surgeon, and the physical character of my district, (which you are personally familiar with,) have hitherto prevented me. I now take advantage of a leisure hour, which after all may be too late for your next number, to place on record the subjoined facts, about which I confess I feel anxious. I have,—and have had for nearly a twelvemonth,—in operation, an *electro-magnetic engine,* of a construction and upon a principle essentially different from any thing hitherto announced. In the course of a series of galvanic experiments, which for several years past have assisted to beguile the intervals of professional labor, my attention was drawn to the mutual action of *rectilineal* and *circular* currents, as a highly promising source of motive agency for practical purposes. After innumerable failures, I eventually succeeded in constructing a machine which may be fairly pronounced *perfect* upon the *actual scale* of its construction; its value upon a *working scale* remains to be proved. The general arrangement of my machine is not unlike the philosophical toy, invented, I believe, by Mr. Sturgeon, of London, as long since as 1828 or 9, of two copper discs, one at either end of a common shaft, revolving each in its own trough of mercury, between the poles of two horse shoe magnets. Such is my machine in general, with the addition of a band or cog-wheel on the center of the same shaft, intermediate between the discs, which revolve between the poles of electro-magnets, without the intervention of a fluid medium of any kind as a part of the circuit; the mode of accomplishing this constitutes the peculiarity of my claim, and you, sir, are competent to appreciate its novelty and its value. My electro-magnets are *hollow,* (another new feature,) and have been made with nearly equivalent results of bar iron, of tinned iron, and of copper.

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* *Remark.*—This letter was too late for the July No. of the Journal. We had hoped to give a figure of Dr. McConnell's machine, but have received no reply to an application for that purpose.—Ed.

The magnets I now have in use, are one inch in diameter, one inch and three quarters between the poles, and five inches and a half in length, each wrapped with one hundred and fifty feet of iron (bonnet) wire. My battery is rectangular, and consists of two concentric boxes of sheet copper, with a zinc box included, the whole constituting a square box open in the middle. The exterior box is seven inches square, the zinc seven deep by six and a half in each of its other dimensions, the interior box of copper seven by six; the whole will contain something more than a quart of the acid menstruum, and presents about two-fifths of galvanic surface in the aggregate. The driving or band-wheel is sixteen inches in diameter, (the discs being nine inches each,) the shaft of iron three-eighths of inch thick and five inches long, working in brass bearings. The battery is charged through a cock in the platform, (which is of cherry, one inch thick by twelve square, and is attached to the battery by screw-bolts,) and discharged when necessary to cleanse or replenish, by a cock near the bottom. The whole swung in *gimbals* between two turned posts, communicates motion from the band through the platform and center of the battery to the propelling wheel, on the axle of a small carriage. The driving wheel revolves when not loaded, (sixteen inches diameter) about two hundred times in a minute, traversing upwards of eight hundred feet! and will revolve *seventy times* per minute, carrying a load of forty pounds, through a space of two hundred and eighty feet, in that time, being a performance nearly equal to the power of three men. The entire machine occupies a space of two feet in height by a foot in breadth, and weighs, when charged for service, seventeen pounds. Touching a small *lever* reverses the action of the engine instantaneously; raising another *arrests* its action, or technically, throws it out of gear. Thus, sir, as you will perceive, my engine differs totally from the ingenious arrangement of Messrs. Davenport & Cooke, of whose galvanic machine your April number contained a notice. Justice to myself, without intending to depreciate in any degree the labors of others, requires from me the statement that my engine, *as it stands*, substantially, was in existence *nearly two years since*, the greater part having been made to my order by the mechanics of this village, in the summer of 1835; an improved portion of the moving parts (of finished workmanship) was made in Philadelphia, as long since as January of the present year, by Mr. J. Mason, philosophical instrument-maker, of Greenleaf's court. I may also state, that Professor Hare, Mr. Isaiah Lukens, Mr. S. V. Merrick, Mr. E. Hazard, and other scientific and personal friends whom I met in society on occasion of a visit to that city at the period above referred to, were cognizant of my experiments and objects many months previous to the public announcement of results of a similar kind from *any other* experimenter. The field of investigation is large, and as yet not much explored, and Mr. Davenport may rest assured, should this notice chance to meet his eye, that no one will rejoice more sincerely than I shall to hear of his onward progress, while I myself hope also to advance in the march of improvement.

3. *Electro-Magnetic Apparatus and Experiments;* by Charles G. Page, M. D.

Salem, (Mass.) Aug. 23, 1837.

TO PROFESSOR SILLIMAN.

Dear Sir—Since my last communication, I have completed the following pieces of electro-magnetic apparatus, for exhibiting the rotation of conductors by magnets, without the use of mercury. The motory force in such experiments is very feeble, but by the use of solid conductors, as in figures 1 and 2, I attain a more rapid movement than when the wires run in mercury. The discovery alluded to in the article on the electro-magnetic engine, viz. the admissibility of oil between conducting surfaces, I conceive to be of great importance, and will doubtless soon change the whole aspect of electro-magnetic and dynamic apparatus. It supersedes the use of mercury, where freedom of motion and the constant passage of the galvanic current are required.

Fig. 1, represents the ring of De la Rive, mounted for rotation between the poles of a horse-shoe magnet. The ring *a*, is four inches in diameter, and consists of eight turns of copper wire, covered with cotton. Its two ends are brought down at *b*, *b*, and soldered to cylindrical segments of silver. These segments are secured upon, but insulated from the axis. Both are to be reduced in size as much as is consistent with strength, in order to diminish friction. The two conducting wires, connected with a pair of plates by the mercury cups on the stand, are bent into a spiral at *c* and *d*, in order to press them with a slight spring against the segments *b*, *b*. Where the instrument is used, a drop of oil is put on the segments. This is a pleasing experiment; the ring (if highly colored) revolving so rapidly, gives the appearance of a hollow sphere. Indeed it would be easy to exhibit two or more concentric rings, revolving different ways, and with different degrees of velocity. I believe this is the first instance of the rotation of a conductor, effected by reversing its tangential action.

Fig. 1.

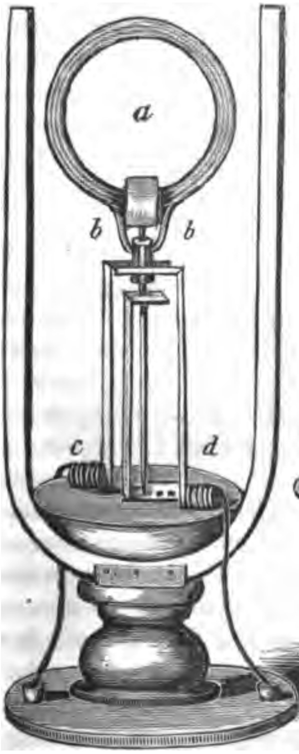

Fig. 2.

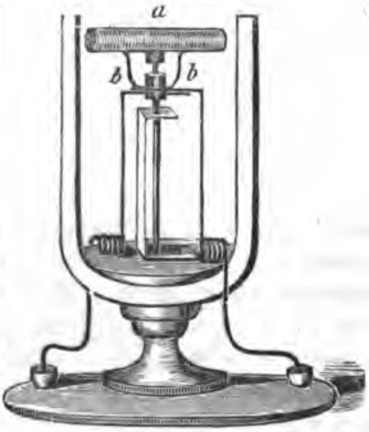

Fig. 2, represents the electro-dynamic cylinder of Ampere, mounted in the same manner as the ring, (fig. 1.) This helix* of wire (called by some the pure voltaic magnet) has its ends bent inward, passing through its axis and brought out at its center, to be soldered to the segments *b*, *b*. The arrangement otherwise is similar to fig. 1. The mode hitherto of exhibiting the magnetic polarity of this cylinder, has been to float it, with a battery, in a large basin of acid and water. This inconvenience might have been obviated by mounting the helix as in the figure, and allowing its ends *b*, *b*, to descend into separate mercury cells; but the use of mercury is objectionable, and by adopting the arrangement described, the polarity of the helix is exhibited in a convenient and pleasing manner.

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* The helix is wound on a cylinder of hard wood, loaded with two buttons, one at each end, to give it weight.

Fig. 3.

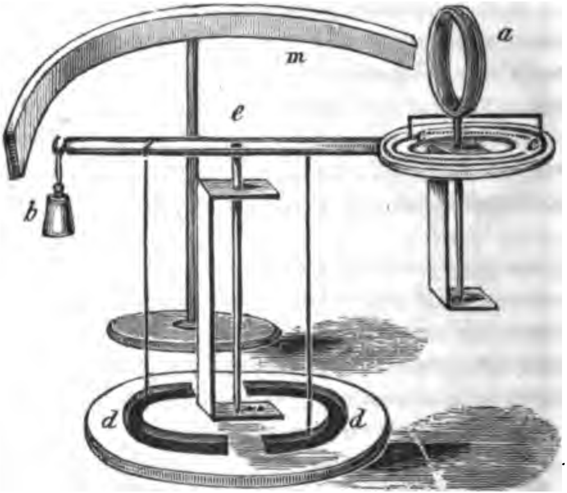

Fig. 3, is a plan for exhibiting the polarity and curious motions of De la Rive's ring, floating in the air instead of acid and water. The great advantage of this construction, and that of fig. 2, is that the ring and helix, and the batteries, may be of any desired size. *a* represents the ring, suspended as in fig. 1. The wire ends descend into concentric mercury cells, *c, c*. These separate cells communicate with the battery cells *d, d*, by wires passing along the slight lever beam *e*. The ring and cells are balanced by a small weight, *b*. The magnet, *m*, supported by its centre, is bent so as to form an arc of the circle described by the ring. Suppose the ring to be in equilibrium at the neutral point of the magnet, *m*. Reverse the battery wires in the cells *d, d*, and the ring starts off from the bar, turns round, presents its other face, and passes on to *m* as before; so that this motion can be produced on a large scale at pleasure, simply by changing the battery wires without disturbing the magnet, as in the floating apparatus. All this can be done with solid conductors, but there being no rapid motion in this experiment, the mercury cells are preferable, from their simplicity.

4. *Davenport's Electro-Magnetic Machine.*—Since the notice of this invention in the April number of this Journal, the proprietors have been engaged in experiments on magnets of different modifications, as well as on the proper distance between the magnetic poles of the circle. The form and arrangement of the magnets have been entirely altered, and the energy of the machine greatly increased. The proprietors have discontinued the use of magnets in the form of segments of a circle and now use them in something like the horse shoe form, changing the poles once in every 3½ inches of the circle. On this arrangement, a machine with a wheel seven inches in diameter, (being but a trifle larger than the one formerly described in this Journal,) elevates ninety pounds one foot per minute, and will perform about twelve hundred revolutions in the same time.

A machine has also been constructed with a motive wheel one foot in diameter, which moves with great energy, but its power has not been tested by the elevation of weights. One of the machines with a motive wheel only seven inches in diameter, has been attached to a turning-lathe, and moves it with astonishing strength, compared with the small size of the propelling engine.

The experiments and improvements hitherto made serve to strengthen the hopes at first entertained in regard to the value and importance of this invention.

The proprietors are now engaged in constructing a machine with a motive wheel of about 2½ feet in diameter, from which they expect to obtain sufficient power to propel a Napier printing press.

For the purpose of raising funds to carry on experiments, &c., a joint stock association has been formed in New York, of which Mr. Edwin Williams, No. 76 Cedar street, is agent. By this arrangement the principal interests of the patent for the United States and Europe, being placed in a stock of 3000 shares, the proprietors offer an opportunity to public spirited individuals to become associated with them in the enterprise, which it is hoped, for the benefit of mankind, may prove successful. A sufficient number of shares, we learn, have been already taken to provide ample funds for experiments on a liberal scale, and the public with interest wait the result.

5. *Pamphlet on Electro-Magnetism.*—A pamphlet of ninety four pages has been published in New York, containing a history of Davenport's invention—notices of it from periodical publications, and

a summary of our knowledge upon the subjects of electricity, galvanism, electro-magnetism, &c. by Mrs. Somerville. If the anticipations of some of the journalists appear extravagant; the summary of Mrs. Somerville, replete as it is with the most interesting and astonishing facts, may well account for the strength of impression produced on the minds of observers by the inexplicable movement of a machine, whirling around with vast rapidity, while there is no obvious cause, and the real cause when pointed out appears so inadequate to the effect.

We rather regret that this interesting application of electro-magnetism is attempted to be sustained by an appeal to the hope of immediate profit. Surely there are not wanting men, and we trust they are numerous, who will cheerfully pay, and, if necessary, cheerfully lose, the comparatively small sums, whose considerable aggregate will carry forward this interesting research, until the ratio and the extent of its power are ascertained; and, if it should prove that the limit is far beyond the demands of practical application, so much the better; but neither the ratio nor the extent can be learned without persevering experiments, the expense of making which and of sustaining all who are concerned in making them, will be, we trust, cheerfully borne by the public.

6. *British Association for the Promotion of Science.*—Extract of a letter to the Editor.

Philadelphia, August 30th, 1837.

My Dear Friend—On the 16th of this month, I sent to the venerable and celebrated Dalton, as chairman of the chemical section of the British Association, a letter, of which I now send you an extract. My motive for publishing this extract in your Journal, is my impression that I owe it to you and others of my scientific countrymen to communicate the facts which I have stated to men of science in the mother country, and that I owe to the latter a more public acknowledgment than I have yet made, of the grateful recollection which I entertain of the kindness with which I was received at their meeting at Bristol. This I am convinced, was intended as a mark of regard, not merely to me as an individual, but to American cultivators of science in general, of whom I was considered as a representative.

The Marquis of Northampton, who presided, stated to me that if there were others of my scientific countrymen present, he wished to be made acquainted with them, as he felt that it would be his duty to pay them attention.

As respects myself, I was received more like an old acquaintance than as a stranger. I was invited to a seat next the Vice President at the dinner, where I believe about four hundred of the members were present, and requested to sit as a member of the committee of the chemical section. On every occasion, I was treated with great deference and kindness.

In the extract sent to you, I have omitted some parts of my letter to Dr. Dalton, as they referred to facts already published in the number of the Franklin Journal for July.

I am faithfully yours, ROBERT HARE.

To Prof. SILLIMAN.

Part of a letter from ROBERT HARE, M. D., *Prof. of Chemistry in the University of Pennsylvania, to* JOHN DALTON, Esq., *Chairman of the Section on Chemistry of the British Association for the Advancement of Science.*

Philadelphia, August 14, 1837.

Dear Sir—I beg leave through you to communicate to the British Asssociation for the Advancement of Science, that by an improvement in the method of constructing and supplying the hydro-oxygen blowpipe, originally invented by me in the year 1801, I have succeeded in fusing into a malleable mass more than three fourths of a pound of platina. In all, I fused more than two pounds fourteen ounces into four masses, averaging of course nearly the weight above mentioned. I see no difficulty in succeeding with much larger weights. The benefit resulting from this process is in the facility which it affords of fusing platina scraps or old platina ware into lumps, from which it may be remodeled into new apparatus.* The largest lumps were fused agreeably to my original plan of keeping the gases in different receptacles and allowing them to meet during efflux. I have, however, operated in the large way upon the plan contrived and employed by Newman, Brooke, Clarke and others, having used at one operation nearly thirty gallons of the mixture of the gaseous elements of water.

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* I have, since this statement was made, been led to believe that fused platina will be free from a fault to which Wollaston's platina is more less liable, accordingly as the process is more or less skilfully managed. The fault to which I allude is that of scaling when extended under the hammer in order to form a crucible or capsule. I had a platina dish of nine ounces in which many scales existed. By fusion, this tendency in the metal appeared to be corrected.

During the fusion of some large lumps which had been imperfectly welded from the state of sponge, vitreous globules were observed to exude. Of this fact I can conceive of no other explanation than one founded on the allegation of Prof. Daniels, that during exposure to fire, platina absorbs silicon.

This I was enabled to do with safety by an improvement in Hemming's safety tube. With this improved plan, I have allowed the gas to explode, as far into the tube of efflux as the point where the contrivance in question was interposed, at least a hundred times without its extending beyond it. Still, however, the other mode in which the gases are separate until they meet in passing out of their respective receptacles, is less pregnant with anxiety, if not with risk. As these elements are known to explode by the presence of several metals, other mysterious causes of explosion may be discovered.

How much do I regret, that an ocean now rolls between myself and those respected and esteemed brethren in science whom this time last year I had the pleasure to meet and greet at Bristol, and to whom I shall ever be grateful for their kind reception. How much would it gratify me, could I exhibit to them and their enlightened visitors, that splendid concentration of light and heat which I have latterly employed, by which a metal infusible in the air furnace or forge, is made as fluid as mercury, so as to be blown off in globules.

With the highest esteem, I am respectfully yours,

(Signed,) ROBERT HARE.

JOHN DALTON, Esq., *Chairman of the British Association for the Advancement of Science.*

7. *Notice of the effect of Solar Heat in raising a Balloon, in a letter to the Editor, dated Hamilton, Upper Canada, April* 17*th*, 1837, *from John Rae, Esq.*—By the action of the sunbeams I caused a body of some pounds' weight to ascend and float in the atmosphere, certainly at the height of a mile, probably of several. I will not detain you with an account of previous speculations and experiments but state the simple fact. Of paper blackened with China ink, of which I enclose specimens, I made a bag—the body of a cylindrical form, one of the ends tapering to a cone. The length of the axes of the cylinder and cone together eighteen feet, the diameter of the former ten feet and three quarters. At the apex of the conical part there was left an opening of about a foot in diameter secured by a circular piece of wire and having suspended

from its center a string eight feet long with a weight of four ounces at the end of it. The whole weighed about three pounds. On exposing this apparatus to the sun's rays, the black paper absorbing them, the interior air is heated and expanded, and the whole rises as a balloon filled with hydrogen gas, or common air heated by combustion. It was on the 10th inst. at half past seven, A. M. that I made my final experiment. It happened, that just at the moment we were engaged at it, an eddy of wind came upon us, a small rent was made in the paper, and we were obliged to let go, though it seemed to be only half filled. It floated, nevertheless, and soon began to expand more fully and to ascend. The wind at the surface of the earth was then about W. S. W., but as it ascended, this new aerial voyager, which, if I may be allowed, I would name the Sun Flyer, getting into other currents, went first south, and then a little to the west of south, disappearing in about fifty five minutes, bearing due south.

Hamilton lies at the head of Lake Ontario, on the western extremity of Burlington bay and immediately beneath what is here termed the mountain—the limestone ridge that surrounds the head of the lake from Niagara falls to near Toronto. From the point where I stood, the summit of this was exactly three quarters of a mile distant and at least two hundred and fifty feet high. At some distance above the trees which fringe the edge of the mountain, this new voyager of the air dwindled to a mere point and disappeared. The morning was very clear and our Canadian sky is very pure. I think therefore it must have been at least twenty miles off and therefore over a mile and a half high. I had calculated somewhat loosely, that it would rise, if no accident intervened, about six miles. These calculations were founded on previous experiments with a small cubical bag about two feet on the side, formed of similarly prepared paper. In this, when exposed to the sun's rays, the thermometer stood at 30°, 40°, 60°, or even 80°, higher than in the shade, (I mean Fahrenheit's thermometer,) and it weighed itself from three fourths to one and a half ounces avoirdupois less in the former than in the latter situation. I am unable to say what the precise buoyant power of the large bag may have been. In a previous essay I had attempted to ascertain this and other particulars by leaving a large opening in the bottom, into which I got, and keeping it fast with strings attached all round; but it then inflated so rapidly that before our preparations were completed the upper part tore away from the lower, and after ascending about one hundred feet upset and came down. It seemed to me from the strings, &c. broken, to have had a force of several pounds.

I have heard nothing of my apparatus since I dismissed it. In the course it took it would pass over a level, woody and thinly settled tract till it came near Lake Erie, then it would be at a high elevation, and might not catch the eye of many individuals. If I calculated its rate nearly correctly it would have gone over two hundred miles before sunset. This would carry it in a right line to the extremity of Ohio or Michigan. It may however have been tossed about by counter currents on Lake Erie and sunk there, or some accident may have happened to it from the rent, which however was near the bottom, and it may have had to come down in mid course and landed in the woods unseen. I do not think it has been caught by any one in Canada or I should have heard of it, as my address was attached to it.

'*Cui bono.*' It is a new power and all such have at last become of use. But I think the Sun Flyer, if kept flying,—(and were its nature understood, this would be an easy matter, for, though it comes to the earth with sun set it would rise with him on the morning,) might be made to communicate to us interesting facts concerning the regions it visits—their temperature, currents, &c. Again, a large one, forty or forty five feet diameter, would easily carry up a man, and if made of proper materials would be safe and more manageable than a balloon, as by means of a valve its power of ascent and descent would be almost unlimited, and all advantage might be taken of varying currents, and the effect of inclined planes, giving diagonal movements. It is also to be considered that sunshine costs nothing.*

8. *Extract of a letter from Mr. Charles Fox, "relative to the motion of the melted grease in a candle while burning."*

My Dear Sir,—My attention was lately called to the motion of the melted grease in a candle while burning, and which I am puzzled to account for: did you ever notice the following?

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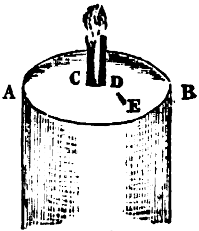
* Clouds too come without cost, and the shading of the sky would of course bring down the voyager. Would this be prevented by artificial heat, or in what manner would the ingenious inventor propose to prevent a descent in dangerous circumstances—on the sea, or a dense forest, a mountain precipice, &c. ?—Ed.

If the small black atoms which are generally floating in the liquid of a candle ready to overflow, be observed, it will be seen that they have a two-fold motion. They are slowly drawn up towards the wick in a straight line; but, when almost touching it, shoot off with great rapidity towards the edge of the candle, instead of being drawn up into the flame, the ends, at the same time, being always turned. For instance, let AB be the circumference of the candle, C the wick, and DE the atom. The end D is drawn up towards C till within the nearest approach it is able to make without touching, when it is suddenly and violently repulsed and turned round, so that D is towards the edge, E towards the wick. This is repeated, generally with much regularity, as regards time and speed, till the candle overflows.



There appear to be always in action two distinct powers, the one of attraction, which I suppose to be capillary, and more easily comprehended; the other of repulsion, which appears commonly, though not always, to act from distinct and fixed points in the wick, in determinate rays towards the edge. The repulsive power is the strongest, and yet extends a very short distance, as the atom is not acted on till it is as near the wick as it can well approach. Is this the action of the whole liquid or only of the extraneous bodies floating in it? These facts I have observed only in spermaceti candles, but presume they will be the same in tallow or wax.

New York, September 8th, 1837.

9. *Supplement to Dr. Mease's paper on Spontaneous Combustion.*—The editor has added a note to the statement of the spontaneous inflammation of horse manure, to show that the case alluded to, p. 151, was ascertained to have been the work of design. That manure will take fire spontaneously is rendered probable by a recent occurrence in Baltimore. In the "Patriot" newspaper of that city of September 26, it is stated that "the alarm of fire on Sunday, was occasioned by spontaneous combustion in a deposite of manure from the stable on the rear of the premises of Edward Patterson, Esq., in South Gay street, near Market street. The situation of the place forbids the idea of any other origin; and it was generally believed by those who saw it to be a case of spontaneous combustion." Who that reflects upon the chemical contents of stable manure can doubt that it contains the principles of combustion?

10. *Another case of the Spontaneous Combustion of Virginia Coal.*—In the month of October, 1837, two thousand bushels of Richmond Coal which had been deposited for some time under a shed on Mr. Lawrence's wharf, in New London, Conn., became ignited. The coal surrounded a post which supported the front part of an open shed. Smoke was discovered issuing from the mass, and on the removal of the coal, the post was found charred. The timely discovery of the fire prevented the extensive conflagration of contiguous wooden buildings.

11. *Meteor.*

Rochester, (N. H.) August 7, 1837.

PROF. SILLIMAN.—*Dear Sir*—You have probably seen some account of the meteor that appeared in this region on Wednesday the 5th ult. I had the satisfaction of seeing it myself as I was walking in the street betwixt seven and eight o'clock in the evening. It first made its appearance from behind a dark cloud, a little to the southwest of this place, and flashed along through the heavens with great majesty and splendor. Its course was to the north, or a little northwest, inclining to the horizon. Its elevation above the horizon was about thirty degrees. Its size was about that of the sun in its zenith, and its color that of iron heated to whiteness. It was visible about a minute and exploded, as it was passing out of sight. Many fragments fell from it, throwing out an intense light of beautiful colors. Many say they heard a report as of distant cannon, though I did not. A long track was left behind it of a grayish color, which continued waving and expanding for some minutes and then vanished gradually away.

This meteor seems to me to confirm the truth of the remarks you made to our class* about the nature of such bodies; that they are not aerial concretions, nor volcanic, nor lunar ejections, nor fragments of a broken planet between the orbits of Mars and Jupiter; but terrestrial comets.

12. *Improved mode of constructing Magnets.*—A paper was read before the Royal Society of London, at a late meeting, "on an improved mode of constructing magnets," by James Cunningham, Esq. The material recommended by the author for the most economical, as well as effectual method of constructing magnets, is cast iron,

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* The writer was a pupil in Yale College.

which should be formed in small castings in the shape of a horse shoe, each weighing about seven ounces; these he finds, on being touched in the usual manner by a small compound magnet, received and retained the impregnation better than any which he had previously constructed of steel.—*Athenæum, Aug.* 26, 1837.

13. *Bones of the Mammoth.*—A part of a mammoth has this day (Aug. 19th) been uncovered in excavating the Genesee Valley Canal, where it crosses Sophia street, in this city. Two ribs, a part of the skull, and of a bone of a leg, and an enormous tusk, have been found. The last, which must have been eight or ten feet long, was chiefly picked to pieces by the Irish laborers, who supposed it to be a *log*, as it had lost its gelatine; about a foot of the smaller end is entire, and there can be no doubt what it once was. It must have been eight inches in diameter in the middle. One rib, which seems to have been a *short* rib, is in a fine state of preservation. Whether the animal was an elephant or a mastodon is uncertain. These remains were found about four feet below the surface in a hollow or water-course, lying on and in a *very hard* body of blue clay, and about two feet above the *polished limestone*, which underlies so great a portion of this city.

The upper surface of the limestone, which is covered with soil and earth from two to six and sometimes to twelve and twenty feet deep under Rochester, is not merely smoothed, but actually *polished*, making a very good *transition* marble. It has in one line been dug through for a *hundred* rods; in others, it has been exposed ten to twenty rods in length; and again, opened only in digging wells. It seems to underlie many hundred acres. C. D.

Rochester, August 19th, 1837.

14. *Newly discovered Ichnolites.*—Facts or specimens in that department of natural history which may be termed Ichnology, or ths science of stone tracks, seem to be rapidly accumulating. Among other localities which have been lately discovered may be mentioned one at Middletown, Ct. where several successive tracks, belonging probably to the ornithichnites of Prof. Hitchcock, may be traced on a layer of micaceous shale in the sandstone formation, the tracks being of a medium size and about fourteen inches asunder. At the same locality, which is about one mile and a half southeast of the Wesleyan University, there have been also found several tracks of

a larger species, probably the O. giganteus of Prof. H. A single four-toed specimen found at this place has been deposited at the Wesleyan University, and which may have pertained to some unknown quadruped. Another locality has been discovered by Dr. Richard Warner, of Middletown, situated about four miles north of the foregoing. It is also understood that Prof. Hitchcock, to whom we are indebted for the development of this subject, has obtained many additional specimens, comprising a number of new species.—R.

15. *Hot Springs of Arkansaw, &c.*—A correspondent under date of July 2, 1837, writing from the hot springs states, that the temperature of the springs is about 154° or 156° Fahr.; that they seldom vary; that the hottest are the largest—that they are numerous, and that some of them discharge a barrel or perhaps fifty gallons of water per minute.

It is stated also that there is abundance of good salt water about forty miles southeast from the springs, and alum in a few places in such abundance and so pure that it is used for all the ordinary purposes. These springs are situated near latitude 34° 30′, and longitude west from Greenwich 93°.

16. *Fire bricks and hearth stones for furnaces.*—In the number of this Journal for April (1837) it was stated that excellent fire bricks had been made by Mr. Isaac Doolittle, then of Bennington, Vermont. That gentleman, now at Fort Ann, New York, requests us to state that the bricks were made by Messrs. L. Norton & Son, of Bennington. Mr. Doolittle adds—" during my connection with the Bennington Iron Works—a period of nearly fifteen years, we made repeated trials of all the most noted kinds of fire bricks, both English and American, and we have found that those manufactured by Messrs. L. Norton & Son, are decidedly superior to all others that we ever used; and I would add, that so far as I know and believe, the same result has been attained by all persons who have used these bricks for lining cupolas, and other purposes requiring a highly refractory and durable article."

17. *Edwardsite.*—Perfect crystals of this mineral have of late been noticed which have the form of the annexed figures. Fig. 1, is the more common form; fig. 2, has been observed in a small translucent crystal. The dotted plane *p*, a basal face of the primary, often occurs as the result of cleavage, and presents a brilliant

lustre. The angles quoted were obtained by Prof. *Shepard* and Mr. *Dana;* those of observation by the former gentleman from the crystal represented in fig. 2, and those of calculation by the latter. The faces of this crystal, though quite bright, were somewhat curved, and consequently there was considerable variation in the angles obtained with the reflective goniometer.

Fig. 1.

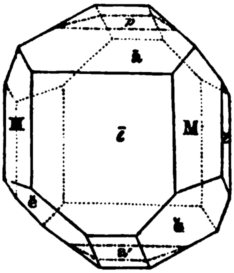
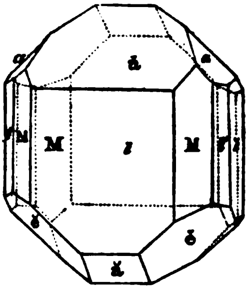


Fig. 2.



	Angles by the Reflective Goniometer.	Angles from calculation.*
P : ē	102° 45′	103° 42′
P : M	100	99 45
P : ĕ		121 46
P : *a*	140 10	138 38
M : ĕ	133 30	133 30
M : ĕ	138	138 29
M : ĕ′		161 17
ĕ : ĕ	106 50	107 6
ĕ : ă	142 30	143 33
ĕ : ē	118	117 47
ĕ : *a*		141 50
ē : ĕ	92 20	90
ē : *a*		100 15
ĕ : *a*		131 22
ĕ : ĕ	126 25	126 27
ā : ă (over summit)	92 30	93 30

The description of Fig. 2, after the notation of NAUMANN, is as follows:

∞P∞ . ∞P . ∞P′∞ . ∞P′2 . P∞ . P′∞ . −P . −P∞ .
ē M . ĕ ĕ′ ā *a* ĕ ă

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* The observed angles assumed as data for the calculation of the interfacial angles of the crystal are as follow: M : ĕ = 136° 30′; ĕ : ā = 140° 10′; ĕ : ă = 126° 25′. The axes, a : b : c = ·9277 : 1 : 1·024. γ = 76° 18′.

18. *Lethæa Geognostica,* oder Abbildung und Beschreibung der für die Gebirgs-Formationen bezeichnendsten Versteinerungen: von Dr. *H. G. Bronn,* Prof. an der Univ. zu Heidelberg, 8vo. with lithog. in 4to. *Stuttgart.* 1835.—This extensive work is devoted to the descriptions and illustrations of the numerous species of organic remains, and when completed will form one of the most valuable treatises on this subject. In the very abundant references to authors, the large number of synonyms given, and the full lists of localities accompanying the descriptions, the work evinces the industry, zeal and accurate science of its author. The lithographic plates which accompany the work, are elegant specimens of this art, and as far as we can judge from the specimens that have come under our observation, are accurate illustrations of the species. We observe among them quite a large number of the fossils of our own geological formations.

19. *Elemente der technischen Chemie*; zum Gebrauch beim Unterricht im Königl. Gewerbinstitut und den Provinzial-Gewerbschulen des preuss. Staats: von ERNST LUDWIG SCHUBARTH, Doctor der Philosophie, Medecin und Chirurgie, ausserordentlichen Professor an der Königl. Friedrich-Wilhelms-Universität zu Berlin, &c. Zweite sehr vermehrte Auflage. 2 Bande, 8vo, mit 20 Kupfertafeln. *Berlin,* im Commission bei August Rücker. 1835.—The work whose title is here given, is a treatise on the application of Chemistry to the Arts, and includes extended observations on the uses and modes of preparation of the substances employed in the various processes in the arts. There are very few of these processes, at the present day, that have not received signal improvements from the discoveries of scientific chemistry, and a knowledge of this subject is rapidly becoming of increased importance, both to those practically concerned and to the community at large. This addition to the small number of treatises on this subject, has therefore been received by us with extreme interest; an interest, which has been much increased by our perusal of the work.

The first volume commences with an introduction to the subject, occupying sixty pages, in which the different kinds of chemical apparatus and modes of operation are fully explained. The author next proceeds to an account of the elementary substances and their inorganic compounds, arranging the remarks in chapters treating severally of the different elements. After thus occupying about one thousand pages, he proceeds to the consideration of organic bodies, describing as before their qualities, uses, modes of application and methods of preparation, with which he completes the last volume of six hundred and fifty pages. The observations on the different substances, are made with sufficient fullness, and contain a vast fund of information, which makes the work interesting to the mere general reader. The descriptions of apparatus are illustrated by twenty folio copper plates of neat execution, in which are given all the details necessary for the construction of the instruments described.

This treatise has been adopted as a text book in the Royal and other institutions in Prussia and in other parts of Europe. The author writes that it is not in the bookstores, but may be obtained from him at a low rate.

20. *Protest of Lt. Mather.**—Many of the readers of the Naval Magazine have probably seen the late Geological Report of "G. W. Featherstonhaugh, U. S. Geologist," upon a geological tour to the Coteau des Prairies. There is no such office recognized by the acts of Congress as U. S. Geologist, a title assumed by Mr. F., in consequence of his having been a daily employé on geological duties under the orders of a Topographical Bureau, which is a sub-office of the War Department.

Mr. Featherstonhaugh and myself were associated under the orders of the Topographical Bureau, and were directed to make a geological survey of the country between Green Bay and the Coteau des Prairies, and were called on for separate reports. While engaged on that survey, I made a sketch of the topography of the country adjacent to the St. Peter's River, and took the bearings and comparative lengths of all the bends, so as to form a map of all the meanderings of the stream, with a view to illustrate the minute, as well as general geology, by references from my report. Mr. F. had no share in the original preparation of the materials for this map. In his published report of that survey is a topographical map of the St. Peter's, which he had plotted, from my original notes, by an officer in the Topographical Bureau, and it comes before the world as a map of the St. Peter's, "by G. W. Featherstonhaugh." It is a copy of mine on a smaller scale, except that he has extended the courses of the streams far beyond where we saw them, and put on it the topography of the Coteau des Prairies as he supposes it, for great distances north, west, and south of where we saw it. The public will now understand, not my surprise at the course pursued by Mr. G. W. Featherstonhaugh, for I am not surprised, but my indignation that he should thus appropriate a portion of my labors *without acknowledgment.*

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* From the Naval Magazine.

Under such circumstances, I deem it a duty to myself and the scientific public, to denounce Mr. Featherstonhaugh to the world, for this, as one instance of his appropriating the labors of others to his own uses without acknowledgment. W. W. MATHER.

21. *New Silk Worm.*—At Maragnan and Rio Janeiro are several species of Bombyx, the caterpillars of which enclose themselves in a cocoon, after having spun a thicker and stronger silk than that of the ordinary silk worm. It has been tried by Padre Mestre, and forms a very solid material. A species of mulberry, the fruit of which is small and inedible, grows near Rio Janeiro, which it is proposed to cultivate for feeding the caterpillars.—*Athenæum, May,* 1837.

22. *New Voyage round the World.*—The King of the French has, by a decision of the 26th of March, approved of a proposal of the Minister of the Marine, for a new voyage round the world, the conduct of which is to be confided to Capt. Dumont d'Urville. Two vessels are to be employed in this expedition: the *Astrolabe,* commanded by Capt. d'Urville, and the *Zélée,* by Capt. Jacquinot. These vessels were to sail from Toulon at the beginning of September last. After a short stay at the Cape Verd Islands, they will go to the South Polar Sea, passing between Sandwich land and New Shetland, in order to explore those seas, in which Weddel alone seems to have been able to reach the 74th degree of south latitude. The expedition will extend its researches towards the Pole as far as the ice may allow; then, turning back towards the north, M. d'Urville will pass through Magellan's Straits, where, notwithstanding the labors of Capt. King, it is believed that an ample harvest of discoveries still awaits the navigators who may explore them. The island of Chiloe, to the west of Patagonia, will then be carefully examined; after which the expedition will go to Valparaiso, to give the crews the repose they will require, and to make such repairs as may be necessary to enable the vessels to prosecute their voyage. Leaving

that port in the spring of 1838, the ships will make for the Polynesian Islands; and, on arriving at Vavaoo, M. d'Urville will employ the first part of June in completing, by new observations, the work executed, in 1827, by the officers of the *Astrolabe*. The vessels will then visit Banks's Islands, to the north of the New Hebrides, which are hardly known, and Van Icoro, where, however, they go merely to visit the cenotaph erected to the memory of La Pérouse, and to obtain further information from the natives. Thence M. d'Urville will steer towards the Solomon Isles; and, if the condition of the vessels permit, he will proceed through Torres Straits, and visit the new Dutch colony, on the river Dourga, the Isles of Aroo and Key, and then go to Amboina. From Amboina the *Zélée* will be sent back to France, so that she will return a year before the *Astrolabe*, and will bring home the collections already made, and the result of the operations performed. The *Astrolabe* alone will then sail round New Holland, and will visit, about November or December, 1838, the colony at Swan River. Hence she will proceed to Hobart Town, and then sail to New Zealand. The months of February and March, 1839, will be devoted to important operations in that great island, especially in carefully exploring certain parts of Cook's Straits, which may afford valuable resources to English whalers. She will then visit the Chatham Isles, respecting which we have had no information since their discovery by Broughton in 1791. Then, steering to the north, M. d'Urville will pass two or three months among the Carolines; and about August he hopes to arrive at Mindanao, where no French ship, it is said, has ever touched; after which, he will visit some parts of the island of Borneo, pay a short visit to Batavia, touch at one or other of the ports of Sumatra, and return by the Cape of Good Hope to France, where he expects to arrive about March or April, 1840, after an absence of thirty or thirty two months. It is unnecessary to point out the interest which attaches to an expedition conceived on so large a scale, and calculated to produce very important results. Two vessels, perfectly well equipped, and commanded by officers accustomed to surmount the difficulties of voyages of discovery, hold out very reasonable prospects of success in such an enterprise.—*Athenæum, April,* 1837.

23. *Greece.*—A society of Natural History has been established in Athens. It was addressed at its first meeting by M. Nicolaïdes Levadiefs, a medical officer under the Greek government. After

pointing out the advantages to be derived from agriculture, of which the Greeks are now comparatively ignorant, although Sicily, a Grecian colony, was in ancient times the granary of Rome, and after adverting to Holland and England, as proofs of what skill and industry might do even with an ungrateful, and under comparatively rude climates, M. Levadiefs proceeded as follows:—"The Greeks formerly worked silver mines in Attica and in some of the islands in the Archipelago; but gold came to them through Macedonia and Thrace, from Pannonia and Illyria. Hence the gold coins of ancient Greece are so few, while those of the Macedonian kings are still numerous. The marble quarries of Pentelicus and Paros are too well known to need being mentioned. Chromium has been found in Eubœa; Milos is rich in sulphur, vitriol and alum; Siphnas possesses silver ores; Naxos maintains a trade in emery; Santorin is rich in steatite, or soap-stone, which is much sought for, chiefly to make the luting of water-pipes. I shall not say any thing of our numerous mineral springs, the waters of which are so serviceable to suffering humanity. Unfortunately, mines cannot be expected to repay the cost of working them, unless where coals are at hand and in abundance. It shall therefore be the business of the society of Natural History to prosecute the much desired examination, as to the nature and quality of the stone coal discovered at Negropont and at Argos, and to report on the uses to which it may be applied, whether as fuel for domestic purposes or for the making of gas; whether it be adapted for the use of furnaces, or smithies, and for steam navigation."—*Ib.*

24. *Geological Society.—April* 19.—Rev. W. Whewell, President, in the chair.—A paper was read by Mr. Owen, 'On the cranium of the Toxodon, a new extinct gigantic animal, referable by its dentition to the Rodentia, but with affinities to Pachydermata and herbivorous Cetacea.'

This cranium forms part of the series of fossils collected by Mr. Darwin in South America. It was found in the Sarandis, a small tributary of the Rio Negro, about one hundred and twenty miles N. W. from Monte Video, and had been imbedded in the whitish, argillaceous earth which forms the banks of that rivulet. The subsoil of the whole of the surrounding country is granitic, and Mr. Darwin considers the argillaceous covering to be an estuary deposit, accumulated by the river now called the Plata, and at a period when the land was at a lower level with reference to the ocean, than it is at present.

The dimension of this interesting fossil, the extreme length of the skull being two feet four inches, and the extreme breadth one foot four inches, amply attest that the species to which it belonged attained a magnitude comparable only with some of the gigantic Pachyderms or the extinct Megatherium.

From the structure of the molar teeth and their continuous mode of growth, Mr. Owen showed that the Toxodon is referable to the Rodentia; but that it differs from the existing animals of that order in the number and relative position of the incisors, and in the number and direction of the curvature of the molars. The Toxodon again deviates from the true Rodentia, and resembles the Wombat, in the form of the articular cavity of the lower jaw. It differs from the Rodentia and resembles the Pachydermata in the relative position of the glenoid cavities and zygomatic arches, and in many minor details. In the aspect of the plane of the occipital region of the skull, in the form and position of the occipital condyles, in the transverse extent of the frontal region of the skull, in the aspect of the plane of the bony aperture of the nostrils, and in the thickness and texture of the osseous parietes of the skull, the Toxodon differs from both the Rodentia and Pachydermata, and manifests an affinity to the Cetaceous order.

From these instances of aberrant characters in the Toxodon, considered as a gigantic Rodent, and which were described in admirable detail, Mr. Owen pointed out, that although the teeth, from their correspondence with many other important parts of the animal structure, and from the the facility of observing them, are highly important and useful zoological characters, yet they are not, in all cases, sufficient alone to determine the order to which a Mammifer belongs; and that upon due consideration it will appear, that dental characters must yield the precedence to the modification of the organs of progressive motion. It may, therefore, be inferred, that those orders in the present received systems of Mammalogy, which are founded on characters afforded by the teeth alone, are less natural, and less important groups, than those which are based on modifications of the locomotive extremities; and *à fortiori*, on those which combine such distinctive characters with equally characteristic peculiarities of dentition. At present there is no evidence to determine what was the nature of the extremities of the Toxodon, but Mr. Owen is of opinion, that although it cannot be positively affirmed the genus may not be referable to the Muticata of Linnæus, yet, from the development of the nasal cavity, and the frontal sinus, that it is extremely improbable the habits of the species were so strictly aquatic as the entire absence of hinder extremities would occasion.

In conclusion, he pointed out the interesting fact, that the recent animal most analogous to the Toxodon, combining the characters of a Pachyderm and a Rodent, and, from its aquatic habits, called the Water-hog, or Hydrochærus, exists only in South America, the same region in which this gigantic fossil, possessing similar aberrant peculiarities, has been discovered.

May 3.—Rev. W. Whewell, President, in the chair.

The first paper read was one by Mr. Darwin, describing the district in which had been found the remains of the Toxodon, described at the last meeting by Mr. Owen. The countries bordering the Rio de la Plata contain, in great numbers, the remains of extinct animals. The province of Bander Oriental consists of granite, and other primary rocks. The flat and extensive plains of the Pampas are very uniform in structure over a very extensive tract. A reddish argillaceous earth covers the surface, with irregular concretions of an aluminous limestone, or indurated marl, which sometimes unite and form a stratum, often replacing the former, both containing occasional layers of crystallized sulphate of lime. In the province of Entre Rios, these rest on strata consisting of sand, layers of clay, and a fine white crystalline limestone, containing shark's teeth, Arca Venus, and Pecten, all resembling recent shells. But it is in the superincumbent deposit that are found the fossil Mammalia, peculiar to this district, consisting besides the Toxodon, Megatherium, a lesser animal, protected by an armadillo-like covering, Mastodon, another singular animal, of which only half the head has been preserved, and, as Mr. Darwin believes, also the horse.

In several places Mr. Darwin observed clear proofs of a change of the level between land and water. These he considers connected with the greater changes on the opposite coast, and concludes that, within a period geologically recent, a great bay occupied the area both of the Pampas and the low parts of Bander Oriental. Into this the river poured, as in the present day, reddish sediment from the decomposition of the granites of Brazil, and charged lime with gypsum, perhaps, from the Cordilleras. The bodies of the animals, which formerly inhabited the surrounding country, must have been likewise swept into this bay, which has now been elevated into dry land.

An extract of a letter, dated 18th November, 1836, from Captain Cautley to Dr. Royle, was next read, permitting the announcement of a fact which had long been communicated to the latter, of the finding of the remains of a Quadrumanous animal in the Sewaliks, or Sub-Himalayan range of mountains. The animal must have been much larger than any existing one, and allied to Cuvier's Cynocephaline group. Captain Cautley also announced the discovery, by Major Colvin, of a specimen of the head of the Sivatherium; in which, in conformity to the conjectures of Dr. Falconer and Captain C., in their paper for which the Wollaston medal was this year awarded, it is found that the animal had four horns; two in front, and two huge trifurcated ones behind. He considers the animal as allied to the Dicranocerine group of Major Hamilton Smith.

A paper, by Messrs. Hamilton and Strickland, was then read, on a tertiary formation in the island of Cephalonia, near Lixouri, on the western shore of the Gulf of Argostoli. The parallel ridges composing it extend for two or three miles to the north and south of Lixouri, sloping to the east, according to the dip of the strata, or from 45° to 55°, and presenting a succession of steep and sharp escarpments towards the west. The conformable beds are of great thickness, and are remarkable, as well for the great beauty and number of the fossils, as for the variety of beds through which these extend. The beds, of which sixteen are enumerated, may be classed under three principal heads: 1. The calcareoarenaceous. 2. The argillaceous. 3. Gypseous beds. The fossils belong to numerous genera, and many of the species are identical with those existing in the Mediterranean.—*Athenæum, April and May*, 1837.

25. *Professor Afzelius.*—Professor Adam Afzelius, the Nestor of scientific men in Sweden, died at Upsal, on the 30th of last January, aged eighty-six years. He was the last pupil of Linnæus, and was celebrated for his travels in Asia and Africa. His African Herbarium, we believe, is now in the Banksian collection in the British Museum. His younger brothers, John and Peter, the first devoted to chemistry, and the second to medicine, are both distinguished for their talents, and have, for nearly half a century, occupied chairs in the University of Upsal.—*Athenæum, April*, 1837.

POSTSCRIPT.

26. *Notice of an Aurora, in a letter to the Editor.*

Burlington, Vt. Sept. 30, 1837.

PROF. SILLIMAN—*Sir*—A few weeks since I observed two auroral phenomena, which seemed so well adapted by their distinctness and steadiness to be identified in other places, that I take the liberty of transmitting a description to you for insertion in your Journal, should you think proper.

On the 29th July, 1837, a luminous arch appeared, commencing 8° or 10° from the eastern horizon: it passed between Alpha and Zeta Pegasi, between Alpha and Beta Lyræ, just north of Arcturus, and terminated 19° or 20° from the western horizon. It was about 3° broad, and well defined. Thus I first saw it about 10 h. P. M. It moved slowly to the south, fading at the extremities: at 10 h. 15 m. it passed over Beta Cygni, faint but still well defined for some distance on each side of the meridian, about 2° broad, but soon vanished, the last traces appearing in the head of Hercules. There was at the same time a bright light along the northern horizon, but it presented no uncommon features.

It is rather remarkable, that about a month afterwards a similar arch should occur at exactly the same time in the evening, and occupying very nearly the same place, but so it was. On the 25th of August it was nearly repeated, the eastern part, however, being a little farther north, touching at 10 P. M. Gamma Pegasi, and in 12 m. or 15 m. moving over Alpha Pegasi, where it vanished; in the west below Arcturus, it sloped off to the northwest, making an angle of 45° or 50° with the horizon. The western part disappeared about 10 h. 15 m. by spreading. The northern light was brighter and more active than before, but too irregular and unsteady to admit a hope of recognition by others.

Within ten years I have seen four similar phenomena, and much to my disappointment they all evince a stubborn aversion to respecting the magnetic meridian.

Yours with high respect,

JAMES DEAN.

P. S. Burlington is in lat. 44° 28′, lon. 73° 15′.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

ART. I.—*A Description of a Magnetic Electrical Machine, invented by* E. M. CLARKE, Magnetician, No. 11, Lowther Arcade, Strand, London.

THIS apparatus, with the exception of there being *rotating armatures* and a *magnetic battery*, differs from any magnetic machine which has hitherto been constructed.

The October number of the *Philosophical Magazine*[*] for 1836, contains a brief account of this machine; it being the intention of the inventor to reserve a more detailed description for insertion in the "*Annals*,"[†] in consequence of its being the aim of the Editor of the latter named periodical to make this deservedly interesting branch of science one of the leading features of that work. Since that time, a most important improvement has been made, by the rejection of the mercury box. By the inventor's present arrangement, the necessity of using mercury is superseded. Fig. 1.

A, is the battery of bent bar magnets, placed *vertically*, and resting against four adjusting screws, which pass through the mahogany back board B, (two of them are shown at M, N, fig. 12.) C is a bar of stout brass, having an opening in the middle, through which passes a bolt with a screw-nut, the purpose of which is to draw the magnetic battery to the board B. By these means, the battery can readily be disengaged from the machine, without taking asunder the entire apparatus, and the battery is thus also freed from that vibra-

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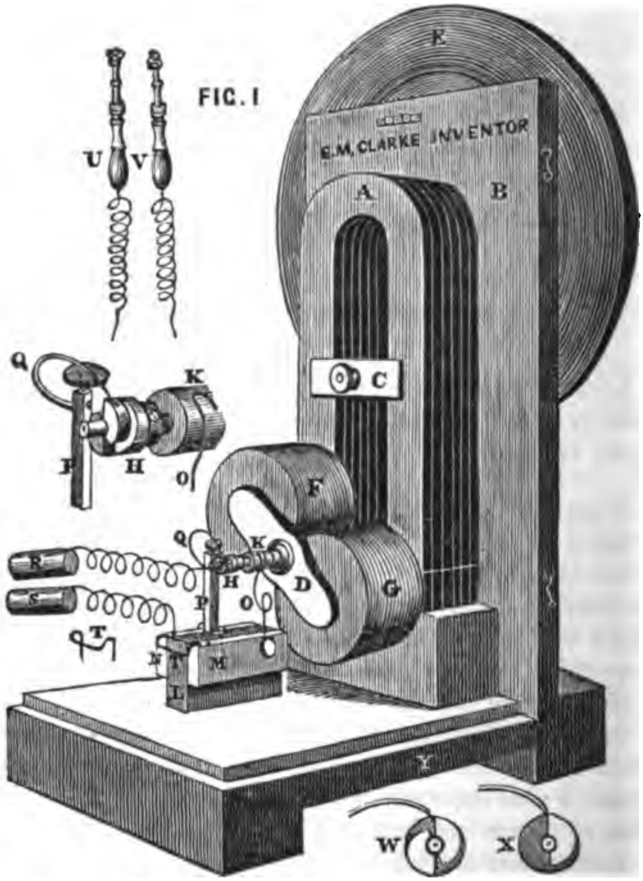
[*] I beg leave also to direct the attention of your readers to No. 55, p. 360, and No. 63, p. 455, of the same Magazine.

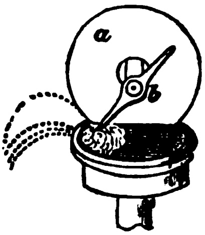
[†] The Annals of Electricity, published by Mr. Sturgeon, at Woolwich, England, and in which this communication was originally published. It has been recently sent with the stereotype plates to the Editor, for republication in this Journal.

FIG. I



tion which must necessarily be occasioned by the attachment of the rotating apparatus to the battery itself. D is the intensity armature, which screws into a brass mandril seated between the poles of the battery A; motion being communicated to it by the multiplying wheel E. This armature has two coils of fine insulated copper wire, one thousand five hundred yards long, coiled on its cylinders, the commencement of each coil being soldered to the armature D, from which projects a brass stem, (also soldered into D,) which carries the break-pieces, H and H. The break-piece is made fast in what position soever is required by a small binding screw. K and K, a hollow brass cylinder, to which the terminations of the coils F G are soldered, being insulated by a piece of hard wood attached to the brass stem. O and O are iron wire springs, pressing against the hollow cylinder K at one end, and held in metallic contact by a nurled head screw in the brass strap M, which is fixed to the side of the wooden block L. P and P, a square brass pillar, fitting into a square opening in the other brass strap N, and secured at any convenient height required. Q and Q, a metal spring that rubs gently on the break-piece H, and held in perfect metallic contact by the nurled head screw in P. T and T, a piece of copper wire for connecting the two brass straps, M, N; then D, H, Q, P, N, are in connexion with the commencement of each coil, and K, O, M, with the terminations. The advantages of this arrangement must be obvious to any person who has seen the magnetic machine in action in the Adelaide Gallery of Practical Science, where the old arrangement of the mercury flood is still used, where both disc and blades scatter the mercury about as in fig. 1′: *a*, the disc; *b*, the double blades; *c*, the mercury flood. The loss of mercury is not the only evil; for as you continue working the machine, you of course, lose the adjustment you had at starting, and the effect is constantly diminishing, and will at length cease, owing to the points *b* not having mercury to dip in. By the new arrangement, the metal spring Q presses gently on the break H; consequently, the effects here are unbroken, no matter how long you may require to keep the machine acting. This is not the only advantage it possesses; for in the mercury the surface is very rapidly oxidated; the oxide adheres to both disc and point, and preventing so perfect a metallic contact as that obtained by the spring and break.

FIG. I.



To adjust the intensity armature.

See that the faces of the iron cylinders that carry the coils F, G, fig. 1, are parallel to, and all but in contact with, the magnetic battery A; if not, unscrew the nut of the multiplying wheel E, and take it off its axis: you then have at your command the four screws against which the battery rests, (two of which are to be seen at M N, fig. 12;) by means of them and the nut of the strap C, you can adjust the battery to the greatest nicety. The next step is to adjust the break, so that the spring Q will separate from it just at the same time that the iron cylinders of the armature have left the poles of the magnetic battery; and lastly, see that the iron wire spring O, presses gently against the hollow brass cylinder K.

To give the Shock.

Grasp the two brass conductors, R S, in the hands,[*] put one of their connecting wires into the holes of either of the brass slips M or N, the other wire into the hole at the end of the brass stem that carries the break H. Connect M N by T, turn the multiplying wheel in the direction of the arrow, and a violent shock will be received by the person holding R S. The shock which is obtained from the intensity armature having one thousand five hundred yards of fine insulated wire, is such that a person, even of the strongest nerves will not readily volunteer to receive a second shock. Indeed the effects are so violent, that the inventor has proposed to many of his military customers that this instrument would be a good substitute for the lash, being capable of producing even greater torture than that brutal instrument, without producing any corporeal injury to the delinquent. Place R S in two separate basins of salt and water, immerse a hand in each basin, and the shock will also be felt very powerfully; this method is to be preferred, as it leaves the person who is electrified the power of quitting when he pleases; not so with the conductors; for the muscles of the arms contract violently, so as to close the hands completely on the conductors, taking away the power of letting them go. If the two connecting wires of R S are put in M N, the shock is not so powerful. The shock can be modified in different ways. By turning the wheel E very slowly, or increasing the distance between the battery A and the armature D, or by making the break H separate from the spring Q when the armature D is horizontal. U V a pair of directors, holding a piece of sponge, each to be used when the electricity is to be applied medicinally. The connecting wires are to be placed in the same way as the conductors are in the figure; the sponges must be wetted with a little vinegar or salt and water, so as to make them conduct the electricity. By those directors a succession of most powerful shocks can be given, when the case requires it; or they can be so modified as to be barely felt by the most nervous patient.[†] Remove T from

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[*] If the hands are wetted with vinegar or salt and water, the effect is considerably increased.

[†] To medical gentlemen, the instrument may be strongly recommended from the following advantages. Its portability; its being always in a fit state for action, even in the dampest weather; the nicety with which the power of the shocks may be increased or diminished. Indeed it combines the advantages of the electrical

M N, put the two pieces of iron wire with an end of each in its place; put the other ends of them into two holes that are in the sides of the battery A; let the wires be sufficiently long to allow the armature to rotate between them. If one wetted finger is placed on the brass stem that carries the break H, and another wetted finger is placed on the magnetic battery, the shock will be also felt. While the machine is so arranged, if you look between the face of the rotating armature and the magnetic battery, vivid flashes of light will be perceived playing between both. This light may also be frequently seen without the wires being in connexion with the battery. Sometimes it will be observed flashing between the coils F G.

To decompose Water, &c. &c.

Fig. 2. E. M. Clarke's arrangement of the decomposition of water apparatus, (see Phil. Mag. for June, 1835.) A, a glass vessel, having a brass cap with hard wood bottom through which two pieces of copper wire pass, having pieces of platina wire soldered to them; place this in M, N; fill the tube B, with water,* thrust it over the platina wires where it will be held by the cork C. Q must rub on the cylindrical part of the break H. Here the gases are obtained mixed.

FIG. 2

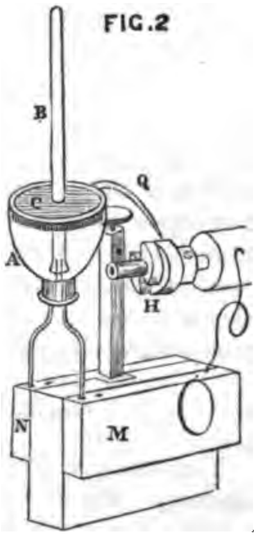

Fig. 3. E. M. Clarke's arrangement of the apparatus for obtaining the elements of water in separate vessels, or unmixed. A, a glass vessel having two glass tubes; here the platina wires are soldered to two pieces of copper wire, as in my other arrangement,

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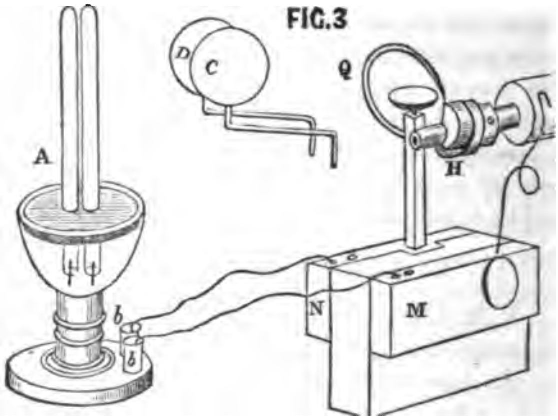
machine and the galvanic apparatus; at the same time that it does not labor under the disadvantages of either; for as has already been stated, it is not affected, like the former, by a moist condition of the atmosphere, nor, like the latter, is it necessary to make use of any acids; nay, since the improvement has been effected which is alluded to in the text, even the use of mercury is superseded.

* The advantages of this arrangement are obvious to any one who has been teased with bits of platina wires made to pass through small holes drilled in a glass vessel having loops turned on the projecting ends, and contact is obtained by merely placing the connecting wire in the loop: it was not only a bad connexion, but in nine cases out of ten the cement that is used to fasten in the platina wires, gave way, just as you were going to use the apparatus, as has frequently happened at lectures.

but differing inasmuch as that they are also soldered to the two brass cups *b b*, which are intended to hold a little mercury. Connect it by copper wire; a little acid or any salt will increase the effect by

FIG. 3



forming a better conductor with M, N, as in the figure. Here Q must work on the single break, H. C, D, two platina plates, having two copper wires soldered to them to connect them with M, N; on placing a piece of litmus or turmeric paper between them that has been previously wetted with some neutral salt, its decomposition is shown by the alteration in the color of the paper. You may even transpose the colors by altering the position of the break H.

Description of the quantity Armature.

This armature differs materially from that which is employed for intensity. The latter, as already stated, has two coils of one thousand five hundred yards of insulated copper wire $\frac{1}{68}$ of an inch in diameter. The inventor has also tried silver wire, which he found to be superior to copper in the proportion of nearly three to one. The quantity of iron in the cylinders also is much smaller than in the quantity armature, whose effects are greatest when the quantity of iron in the cylinders is increased, and the length of the copper wires diminished; the wire at the same time for quantity being much thicker. The quantity armature contains only forty yards of insulated copper wire $\frac{1}{18}$ of an inch in diameter.

To adjust the quantity armature and exhibit the spark.

Fig. 4. A, the magnetic battery; D, the armature, having two coils of insulated copper wire twenty yards each. Care must be taken that the spring separate from the break at the same time that the armature is vertical, being then in a neutral position as respects the poles of the battery.

FIG. 4.

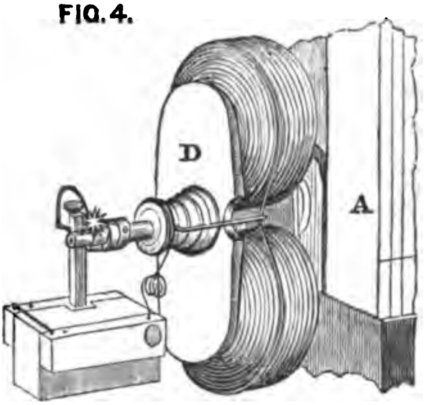
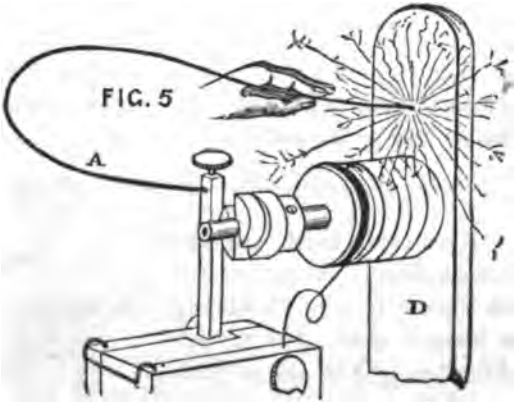


FIG. 5



To scintillate iron wire.

Connect one end of a piece of iron wire with the square brass pillar, fig. 5, pressing the other end gently on the surface of the rotating armature, and brilliant scintillations will be obtained. This effect cannot be produced by any magnetic machine unless it be constructed similarly to E. M. Clarke's; the effect depending upon the wires being *soldered* to the armature; whereas, in other armatures the wire is insulated throughout.

To make platina wire red hot.

Fig. 6, shows the arrangement for this purpose, A being placed in contact with P and H. Whilst the platina wire is red hot, ether may be inflamed, gunpowder exploded, and other experiments of a similar nature be performed.

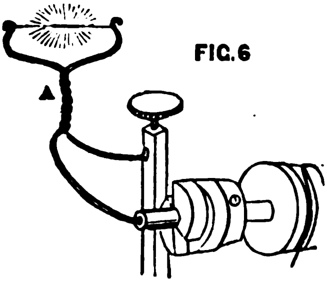


FIG. 6

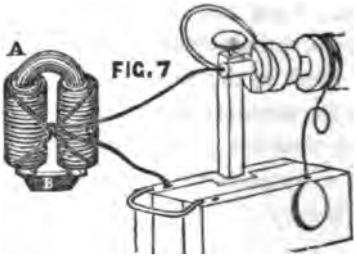


FIG. 7

To render soft iron magnetic.

Fig. 7. A, a piece of iron bent as in the figure. B, a soft iron keeper, which adheres to the iron on the connexion being made as represented, so long as the machine is in action.

To obtain sparks of various colors by the use of different metals.

Fig. 8. Remove the break, and substitute the brass piece B. Into the small hole insert a piece of wire C, of any metal, for instance gold. Let the extremity of the spring Q be also of gold. On rotating the machine, sparks of a purple color will be obtained.

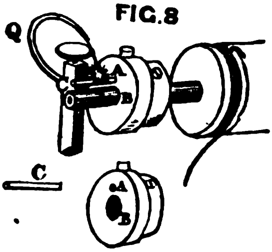


FIG. 8

To exemplify the disadvantages attending the mercury flood.

Fig. 9. Remove the break, and fix the double blades B, in its place. Adjust the brass cup A so that the point will leave the surface of the mercury when the armature is vertical. The brilliancy of the spark, as thus obtained, appears much greater that it is in reality, the additional brightness being occasioned by reflection from the surface of the mercury. It is almost unnecessary to point out

the evil that arises from the scattering of the mercury, not only in point of cleanliness, but expense. A little ether, spirits of wine, or naphtha, being poured on the mercury, is readily inflamed. The same experiment may be satisfactorily performed, by pouring any of those liquids into a test tube C, and holding it over the break. The vapor will speedily be ignited by the magnetic spark; or, dip a piece of paper in ether and hold it over the break and it will soon ignite.

FIG 9

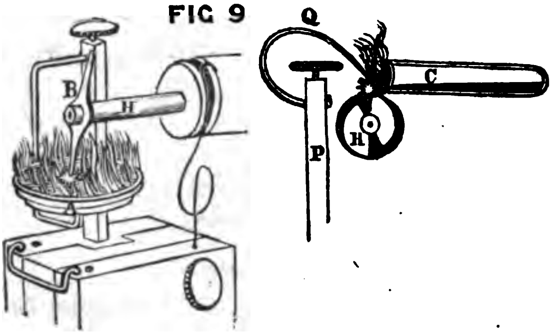
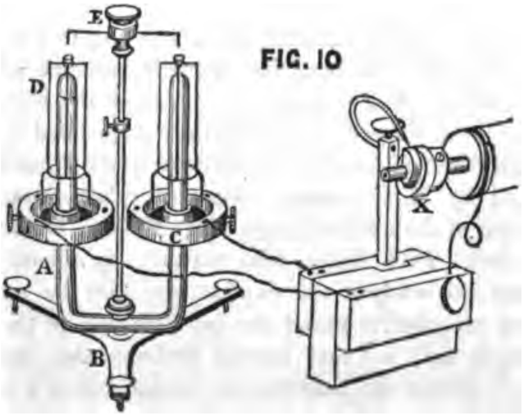


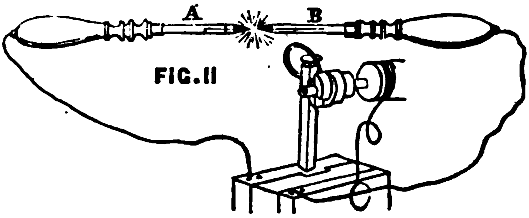
FIG. 10



To produce rotation by magnetic electricity.

Fig. 10. A, a vertical horse-shoe magnet, on a tripod stand B; C, improved flood cups; D, the wire frames, having two little cups at top to hold a drop of mercury; E, a connecting fork. Mercury being poured into the flood cups C, and the single break X being used, on placing the connecting wire as in the figure, continuous

rotary motion will be produced by this arrangement, the current being constantly in the same direction. But the experiment may be varied by substituting the double break H, (fig. 1,) the currents now alternating.*



To ignite Charcoal.

Fig. 11, represents the arrangement of the apparatus for this purpose. The same directors that are used to hold the sponges, may be used to retain the charcoal points A, B, in the proper position.

Fig. 12, shows the compactness of the machine. H, a mahogany case sliding on the bottom board Y, which locks against the back board B. The muliplying wheel is to be turned in the direction of the arrow G. D, the pulley, and C the mandril that carries the armatures.

E. M. Clarke on the occasion of his last visit to Paris, had the honor to exhibit the effects of the magnetic machine which forms the subject of the present paper, to several of the French savans, all of whom were pleased to express their unqualified approbation. M. le Baron Seguier, brought the inventor to the French Institute, accompanied by M. Chevalier. Amongst others present, during the exhibition of the machine, were MM. Melloni, Dulong, Savary, and Becquerel. Prof. Arago, who was that day officially engaged, having heard the result of the experiments with the machine, requested the inventor to attend the day following at the Observatory, which he did; and that learned professor also expressed his satisfaction. On the day following, in consequence of a note received from M. Pouillet, he attended at the Conservatory of Arts and Sciences, when that learned professor, who, of course was well acquainted with the previous magnetic machines, as Pixii's, Newman's, (the name by which Saxton's machine is known on the con-

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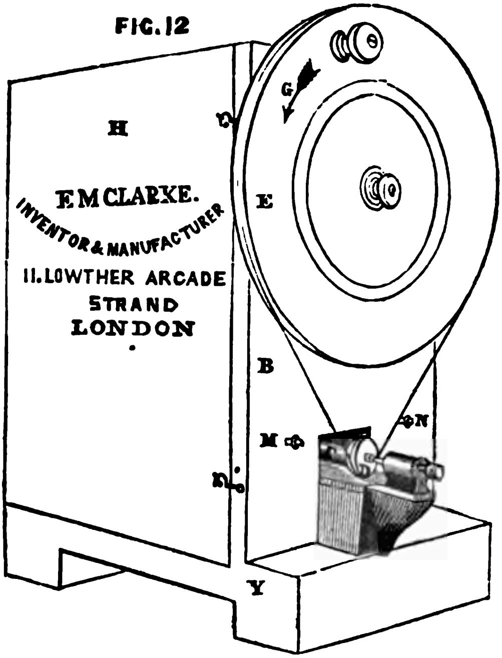
* A singular fact connected with this experiment is the rotation of the two wire frames in the same direction, owing to passages of the electricity from one of the wire frames into one pole of the magnet, and then from the other pole of the magnet down the other frame.

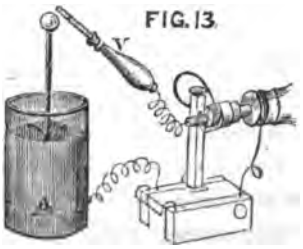
FIG. 12



tinent,) &c. gave the decided preference to E. M. Clarke's arrangement; in proof of which, he was pleased to direct that one should be constructed for the Conservatory of Arts, and another to be deposited in the cabinet of his royal pupil, the Duke of Orleans.*

To charge the Leyden jar and deflect the gold leaves of the Electroscope.

FIG. 13



Twist a piece of copper wire round the outside coating of the Leyden jar, A, Fig. 13; connect it with the block of the magnetic electrical machine. Withdraw the sponge from the director V, and connect its wire with the end of the intensity armature, as in the figure. Rotate the armature at a moderate speed, hold the director by the wood handle, and make it touch the ball for a moment only, as on that depends the success of the experiment, as it is only one spark that shows the fact. Should the director rest on the ball so as that two or more sparks are obtained from the armature you fail. Bring the ball of the Leyden jar in contact with a delicate gold leaf electroscope and the leaves will be diverged. Very little practice will make you perfect in developing their effect. The jar is charged to a very low intensity indeed; but I found that after diverging the gold leaves, if I put my hand on the electroscope so as to discharge it and the gold leaves collapse; on touching the electroscope with the ball of the jar, again the leaves diverged with as much energy as before. I again discharged the electroscope, and again produced a divergence: this I repeated thirteen times, with the same effect each time, from the one charge. I had not time to pursue the experiment further, but would be glad to know to what extent it could be carried. The jar I used was eight inches deep, five and a half inches diameter, open at the top; the tinfoil coatings were six and a half inches deep.

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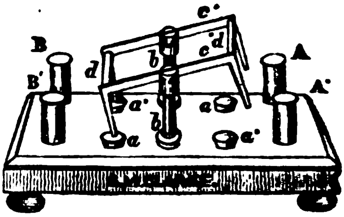
* This order has been executed to the satisfaction of all parties.

ART. II.—*Description of* E. M. CLARKE's *Electrepeter;** from the Annals of Electricity, No. 1. Vol. I.

TO W. STURGEON, Esq.—*Dear Sir*—Understanding from you that descriptions of new philosophical instruments will find a ready insertion in your valuable work, I therefore send you a description of an instrument of my construction for changing the direction of electric currents, named by my worthy classical friend, Dr. Murphy, an *Electrepeter*. This instrument, you, sir, as a public lecturer, can fully appreciate; knowing the facility it affords of showing the changes that are produced when the directions of current are reversed.

The most interesting application of this instrument is that when applied to an apparatus of your invention for showing the attraction and repulsion of voltaic currents when induced in a mobile wire frame, timing



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* It will be perceived that this apparatus bears a great resemblance to that of Dr. Page, described at p. 354, Vol. xxxii. of this Journal, and called the Dynamic Multiplier.—ED.

the reversion of the electric currents, continuous rotary motion of the wire frame may be produced by the earth's magnetism.

A, A′, B, B′, four brass cups screwing into and passing through the bottom board. *b*, *b*′, two brass pillars also screwing into and passing through the bottom board, having slits filed in their heads, into which two movable brass frames *c*, *c*′, fit, being connected by the two ivory rods *d*, *d*′; four brass studs *a*, *a*, *a*′, *a*′, screw into and pass through the bottom board, their upper surfaces being slightly concaved. The cups, studs, pillars and frames, are connected underneath the bottom board by pieces of copper wire soldered to them, as follows:—

Cup A, and studs *a*, *a*.
Cup A′, and studs *a*′, *a*′.
Pillar *b*, and cup B.
Pillar *b*, and cup B′.

Consequently whichever pole of the voltaic, magnetic, or thermo-electric battery is in the cup A, the current passes on to the studs *a*, *a*, up the frame *c*, down the pillar *b*, on to the cup B. If you now reverse the position of the frames so as to bring their points in connection with the other two studs, then the direction of the same current will be from cup A, to stud *a*, up frame *c*′, down pillar *b*′, on the cup B. It is only necessary to pour mercury into the four cups for the convenience of connecting the Electrepeter with the battery at one end, and the apparatus for the experiment at the other; it being immaterial which end you use.

It may be necessary to mention that when I first constructed this instrument I showed it to Dr. Faraday, who thought he had seen one like it described in some of Arago's papers; but on referring to his writings, he found that he had a contrivance for producing the same effect, but not so simple as mine. The Rev. T. W. M'Gauley exhibited, in part of his very ingenious electro-magnetic experiments, an instrument to produce similar effects; but on referring to p. 307, of the Philosophical Magazine for October, 1835, you will perceive mine is more universally applicable.

Believing that no person is better qualified nor any one more deserving of success in your present undertaking,

I remain, sincerely, your obliged friend,

E. M. Clarke, *Magnetician.*

No. 9, Agar St. West Strand, London, Sept. 21, 1836.

ART. III.—*Some observations in Holland, connected with our Prairie region.*

Dry Prairies.

Ridgely, (near Portsmouth,) Va., Sept. 28, 1837.

TO THE EDITOR.

Dear Sir—In some early numbers of the Journal of Science there is I observe, a discussion respecting the origin of our western prairies, some of the writers attributing it to water, others to fire. My object in writing to you is not to meddle with the theory either of these Neptunians or Plutonians, but to state a circumstance which I observed a few years since in Holland and which may be useful to others in forming theories.

I spent the winter of 1831–2 in Indiana, and had then an opportunity of seeing some of our smaller prairies. My residence was on the border of what are there called "the barrens," a district sufficiently fertile, but so called from its being less productive than the rich open prairie country adjoining. As far as I could learn, the prairies are arranged in the following manner.

There commences near the southern termination of Lake Michigan, one of prodigious dimensions, being in many places one hundred and fifty miles in width. It extends transversely across the state of Illinois and passes down through Arkansas and Texas probably to the gulf of Mexico. It has numerous islands of trees scattered over it, and large promontories running out from its sides, but goes off in an unbroken stretch far to the south.

This great prairie is bordered on the eastern side by a district about fifty miles in width which is occupied by smaller prairies, detached from each other by wood land, and of various dimensions. They are often as much as sixty miles in length and twenty or twenty five in breadth: but generally they are smaller, the average being about one third of those dimensions. The soil and natural products in these do not differ from those of the large prairie just noticed. In my rides over them I sometimes carried an auger with me, and on boring, found the surface to the depth of about eight inches to consist of a black loam exceedingly rich: beyond this depth it began to change to a yellow color, and at twelve inches from the surface I came to a yellow clay. Below this they come in digging wells to rolled pebbles; the thickness of this stratum I am unable to state. Black walnut, which is considered as an evidence of good soil, is very common in all this region. The prairies are sometimes perfectly level but generally are rolling, the swells being often thirty or forty feet high and an eighth of a mile or more across. The prairie is seldom lower than the wood land that surrounds it, and the tops of the swells are frequently much higher: the soil in the wooded portions is very similar to that of the open prairie.

Having crossed this region of smaller prairies we come on its eastern border to a district entirely different. This is the strip of land two or three miles wide which they call "the barrens." This consists also of an intermixture of prairie and wood land, but the prairies here are quite small, are lower by ten or twenty feet than their adjoining wooded borders and are what are termed "wet prairies." In winter they are usually covered to a depth of from one foot to three feet with water and are dry only in midsummer. They produce a rank grass that often grows to the height of nine or ten feet, and the soil, a black tenacious mud, is of unknown thickness. In some places they have reached to a depth of fifteen feet without penetrating it. These prairies vary in extent from two acres to three or four hundred acres; it is not often, however, that they attain the latter size, the average being about eighty acres. The trees in this district are almost uniformly white oaks: hickory occurs sometimes but in most cases of small size. You are, I suppose, aware that throughout the woods of the prairie country, there is seldom any undergrowth. The oak trees of the "barrens" often attain a height of forty feet without a branch and are perfectly straight. The little prairies are numerous, occupying about half of the land; their outline is waving and abounding in every variety of form, one prairie often leading by a narrow passage into another: the trees are frequently grouped in a manner that art would fail to imitate, presenting glades and other openings: being free from underwood we can see among them to a great distance, and the appearance of this region either in solitude or when the roads winding over it are enlivened by passengers, or the deer are seen feeding on its luxuriant grass or bounding over its hills, is very beautiful. I have not seen a gentleman's park any where in England that I thought could equal what nature has here spread out with a lavish hand. I have spoken of the soil in these small prairies: that of the wood land which is intermixed with them is entirely different. The surface of the ground in the wooded portions is also quite unique. It is rolling, but the swells here instead of being long and regular as in the districts of the larger prairies, are short and abrupt. They are generally from twenty to forty feet in height, and bear a considerable resemblance to the waves of the sea as I have seen them in the Mediterranean when a heavy storm has been succeeded by a calm, except that these hills are higher. The swells of the larger prairies may be compared to the more dignified heavings of the Atlantic when similarly situated.

You will wonder what all this has to do with Holland, and that I am now going to state. I must further premise, however, that while the soil of the prairies in this last region is a thick black mud, that of the wooded portions is sandy. On the surface it is composed of a yellowish sand, mixed sufficiently with decayed grass and leaves to give it a kind of ash color. At the depth of three or four inches we come to a purer sand with a slight intermixture of clay. Having occasion for sand in building during my residence there, I dug into the side of one of the hills of the "barrens" and was surprised to find at the depth of thirty inches *sand almost entirely pure*. Whether this is the case in all this region I cannot say, but I should judge that it is.

On leaving this third prairie district with our faces eastward, we enter immediately into a region entirely flat, thickly covered with huge trees and undergrowth, with a rich soil and where any one has patience to clear it, well repaying the labors of the husbandman. We have in fact now left the country of the prairies.

I travelled through Holland in a manner, (i. e. on foot,) that allowed me to go whithersoever curiosity might lead. Having entered at its northern border and passed on to the sea-board, I determined at some spot along the coast to examine the natural dykes thrown up by the sea, of which I had no very definite idea. I had never met with any detailed account of them, and supposed them to be a strip of sand-bank washed up by the waves, eight or nine feet high and about twice as wide, on which a person might walk and look directly down on the sea on one side, with the meadow land immediately adjoining on the other.

Soon after leaving Leyden for the Hague, I turned from the thronged highway, and after crossing a rich cultivated district of two miles in width, found myself at the edge of the ocean dyke. But it was far different from what I had anticipated. I saw on approaching it that it was much higher than I had supposed, and when I sprung up the side of the huge bank, instead of having the North Sea directly at my feet, I saw before me what seemed as if it had been an ocean of fluid sand, (if I may use so unphilosophical a phrase,) arrested suddenly after a storm and set at rest. Having entered upon it, I was soon in as entire and dreary a solitude, as if I had been on the burning deserts of Africa. Not an insect crossed my path, and I wandered on from sand hill to sand hill till I grew weary of the labor. Only at one place was there any sign of vegetation. It was at a spot where, for some cause or other, a basin had been formed, capable of retaining moisture, and in this, some grass and a variety of bushes had grown up. All the rest was a succession of sand hills. I crossed this dyke transversely, but computed its direct breadth to be at least two miles. The hills of sand I judged to be from thirty to fifty feet in height.

As I walked on, the strong resemblance between the surface of this place and that of the wooded region in the "barrens" of our prairies struck me repeatedly and forcibly. I had here also the commencement of a little lake or prairie, and they appear also to be both composed of the same material, a pure sand. I had often while out in Indiana, been puzzled in attempting to account for what I saw there, and now a theory flashed upon me, with which I amused myself while toiling over the sands. But I began this letter by saying that I was only going to state facts, not theories; and indeed I soon became glad to shorten my speculations and make for the nearest point of the coast, for I found the hills of loose sand sometimes terminating with a perpendicular face, down which, if I had happened to stumble, I should have brought a torrent of sand after me, sufficient to bring my speculations and myself to an untimely end. I was really glad when the North Sea, covered with white caps, and studded with numberless sails, burst upon my sight.

It is easy for a person walking along the shore to see how this broad belt of sand hills has been formed. The coast is shoal and the waves wash up the light sand, which as soon as it is dry, is caught up by the wind and whirled into the piles which have been just described.

Abreast of the Hague is an opening or cut through this bank, apparently partly natural, and partly artificial. It is about fifty feet wide, is level, and planted with an avenue of noble trees, and forms the communication between this city and its little sea-port Schefeningen, if sea-port that can be called, where *port* there is none, and where vessels that would be safe must be drawn high and dry upon the beach.

My letter is already longer than I intended, and I will only add, that as I came down the banks of the Rhine, I passed at Eltenberg a very high ridge of sand, extending it appeared to me, across the valley of that river. After entering Holland I crossed, also, just south of Arnheim, another such a sandy ridge running from east to west, but much wider than the former, being about fifteen miles across. Then we come again to low flat land, and lastly to the sandy strip or dyke at the coast. Query.—May not the shore of the North Sea have been in remote times at Eltenburg, and then again near Arnheim, and those two belts thus also once have been ocean dykes?

Yours, respectfully, GEO. JONES.

Prairies of Ohio.[*]

Although prairies have been almost universally admired, yet little has been said in relation to their special formation, or the geology by which they are distinguished from other lands. This is specially the case with the wet prairies, in the Northern sections of Ohio. It is true their origin has given rise to various conjectures among geologists, but their structure has never been studied, with sufficient care, to enable them to arrive at correct conclusions. Their botany and zoology have met with more attention than their geology, but, even here, much still remains to be done.

The natural history of dry prairies has been less neglected than that of the wet. The magnificence of their scenery has invariably been the theme of the traveller, and the extent of their boundaries, and varieties of production, both animal and vegetable, have contributed largely to the embellishment of the pages of descriptive writers. The poet and the painter have also resorted to them, in search of objects to engage either the pen or the pencil. The wide unbroken plain, covered by a rich carpet of green, gold and purple; the tall grass waving in the summer breeze; the immense variety of flowers mingling their odors with the winds; the occasional clump of trees rising above the other vegetable growth; the distant herd of buffalo, cropping the grass or flying from the hunter, and the sun sinking amidst grass and flowers, must furnish a scene which can be but faintly described by either, but well worthy the genius of both. Late in the autumn, the fires which destroy the growth of the preceding year, in both wet and dry prairies, are frequently awfully sublime. When seen, at night from a distance, a chain of fire seems to extend, in every direction, as far as the eye can reach. The blaze often rises, in vast coruscations, far above the plane of the horizon. All beyond, presents to the imagination, a chaotic waste, while the earth and the heavens seem to be fast terminating in one grand conflagration. But we will leave the description of such scenery to the graphic pen which has already delineated it, and proceed to the proposed detail of our observations, on some of the wet prairies in the northern sections of Ohio.

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[*] From the Western Monthly Magazine, of February, 1836.

These marshy plains, though frequently quite extensive, are always much less so than many of the dry prairies of the Western States. They are always surrounded by hills, which vary in height according to the extent of the prairie. Their bases contain large quantities of water-worn pebbles, with a few fragments of fresh-water shells, in a state of partial preservation. The soil of the prairie consists of a deep vegetable loam, covered by tall grass and flowering herbs, except where it is too wet to produce any thing but moss and other water plants. In every part of the prairie the tufts of grass and flowering plants rise three or four inches above the most inferior surface, which is covered, except in the dryest part of the season, with water to the depth of from two to six inches. These tufts, however, are so nearly connected, that the water is never seen, except where the grass is cut, or thrown aside. The soil and productions gradually change, as we proceed from the edge to the interior of the grassy flat. Here we find a number of ponds, or small lakes, varying in size from a few rods to one or two miles in circumference. The largest of these ponds are well stored with fish, many of which differ but little, except in size, from those found in the northern lakes. The only woody plant that grows on the edges of the ponds, belongs to the *Salix*, or willow tribe, except in a few instances, where they are thickly surrounded by a dense growth of alder, (*Alnus serrulata.*) These ponds, however, from causes which will be presently noticed, are gradually disappearing, and their places being supplied by the surrounding prairie growth.

The bogs, or marshy flats, so abundant in wet prairies, constitute one of their most singular features. They are occasionally covered, either by a thin sod, or large tufts of grass, similar to those constituting the grassy surface of the prairie, only much larger. Upon attempting to walk over either of these, the ground beneath will shake for the distance of several rods. Sometimes they are very narrow; at others, they cover an area of many acres. Animals are often lost when attempting to cross these shaking bogs. Their depth must be great, for poles have been thrust into them thirty feet in a vertical direction, without reaching a hard bottom. Horses and cattle were frequently lost by the early settlers in such humid marshes. These are, also, generally disappearing, by being covered with a dense sod, which supports a luxuriant growth of grass, and other vegetables. Still it is dangerous to drive heavily laden wagons or carts over them, for the surface occasionally gives way, and the whole sinks into the dark mud below. An instance of this kind occurred, a few years since, in the district which I have been attempting to describe.

But the woody islands, which rise far above the tall grass, contribute much to the beauty of a wet prairie. Their timber consists of oaks, and other trees and shrubs, similar to those found on the neighboring elevations. Pebbles and shells, even more perfect than those imbedded at the base of the surrounding hills, are also abundant below the soil, at the termination or shore of the islands.

A stream of water passes either through those prairies, or in their immediate vicinity. When it overflows its banks, so as to cover the low grounds with water, the whole presents the appearance of a fresh-water lake, with a variety of small islands scattered over its surface.

Marshes, thickly set with willows, alders, and a great variety of flowering shrubs, principally of the rose kind, are sometimes abundant along the margins, or even in the central portions of wet prairies. Here water animals, such as the muskrat, otter and mink, were once abundant, and are so still, except in the immediate neighborhood of settlements. The first of these animals appears to delight to dwell in villages, placed at some distance from each other, while they keep up a constant intercourse by travelling. This is done late in the evening. Their houses are usually six or eight feet in diameter, at the base, and about four feet in height, gradually rounded at the top in such manner as to turn the water in every direction. It is said, by most writers, that they build a new house every year; but this is not correct, for I have known them to occupy the same dwellings for several years in succession. I have counted fifty of these houses, in a shallow pond, within an area of one or two acres; and seen hundreds of their inhabitants playing in the evening, in one of their villages, apparently in the full enjoyment of all the pleasures of association. They always enter their houses by subterranean passages, which commence beneath the water some feet distant.

Beaver dams have been abundant along the streams in the vicinity of these marshes, but their remnants only are now to be seen; the animal having fled with the Indian and buffalo, far beyond the confines of civilization. It is singular that this animal always chose to construct artificial ponds, rather than occupy those already furnished by nature, though but a short distance from its adopted location.

The hills, bounding the wet prairies, which have fallen under my notice, are composed chiefly of a blue dense sandstone, or *gray-wacke*, with little or no calcareous deposit, or impress of organic remains. The *alluvion* of prairies rests upon a blue carbonaceous clay, abounding in roots and trunks of trees, with other vegetable remains, scattered from ten to one hundred feet beneath the surface. Salt water has been obtained, in the vicinity of these prairies, at the depth of six or seven hundred feet; but I have never been advised of the strata through which the auger passed. The water was procured about three hundred feet below the level of Lake Erie, and the same distance beneath the bed of the Ohio, at the mouth of the Muskingum.

So much for a description of wet prairies: let us now turn our attention to their origin.

Without stopping to examine the various hypotheses which have been suggested from time to time, to explain the origin of wet prairies, the facts already mentioned would seem to indicate, that they were either the basins of lakes, or excavations in the beds of ancient rivers, filled by natural causes. The water-worn pebbles and fragments of shells, the animal and vegetable remains, and the small lakes already mentioned, are sufficient evidence that large quantities of water must, at some period or other, have existed between the elevations now enclosing the prairies. It is also worthy of remark, that bowlders and other fragments of primitive rock, are scattered over the neighboring hills, and along the margins of these prairies, while they have never been found upon their surface. It is said they are scattered over the wet prairies of Champaign county, Ohio, but if so, these are entirely different in character from the prairies I have attempted to describe. They must have been formed *upon* the bed of some ancient lake, after its waters had escaped, while those to which I have so often referred, were the offspring of a filling up of a former basin, by the *debris* of the adjacent elevations, assisted by the peat moss of their waters, and the timber and remains of animals brought into them by the streams. It is in this manner that the small lakes in the interior of wet prairies are now gradually disappearing. At first, the water leaves a kind of shaking bog, similar to those already mentioned, but this eventually loses its humid character, and presents a deep black mould, differing in no respect from that found elsewhere in the low lands. The woody islands, or many of them, at least, were once undoubtedly surrounded by water, which must have beat against their shores for a long time; for if this were not the case, the quartz pebbles could never have either reached their present locations, or been reduced to a rounded form. It certainly required much water, time and attrition, to perform so important a change. The pebbles could not have been driven over the prairie, for none such are found upon its surface. Blocks, or large bowlders of granite, have been detected, when boring, deep beneath a wet prairie soil. These must have been transported here at the time the same species were lodged upon the surface of the surrounding country. The basin of the prairie must also have been filled with water, at that period, otherwise they could not have descended so far beneath the surface.

But wet prairies do not remain such continually. Many of the causes which aided in their formation, are now contributing much towards their destruction. The *debris*, consisting of sand, gravel, and clay, of the higher lands, is gradually converting their borders into a sandy soil, followed by a growth of timber, and other vegetables, peculiar to the upper lands. At first the ligneous productions consist principally of a variety of hazel and oak, none of which attain a large size. This growth, however, soon gives place to another, which continues to extend until a dark forest has taken the place of grass and flowers.

Cultivation also contributes much to the destruction of prairies, by the introduction of grasses and plants essentially different from the wild growth. The enclosures, likewise, arrest the fires, alluded to in the beginning of this paper, and thus prevent the annual destruction of shrubs, and the small sprouts of arborous plants. When these fires are prevented from sweeping over the surface of wet prairies, for several years, they are soon covered by a dense growth of alder, which eventually gives place to the vegetables named in the former paragraph. This change, however, does not take place, until the soil has changed its character, by the introduction of sand and gravel from the surrounding elevations. This is effected rapidly after the hills and table lands are cultivated; for when the soil is broken, it is easily driven downwards by rains and running streams.

Thus the immense natural meadow; the residence of the beaver, the otter, and the water-rat; the place of grass and flowers, is reduced, by natural causes, to a dense forest, furnishing timber, and other materials in agriculture, and the arts. The basin of the lake, over which the Indian paddled his bark canoe, is filled, and its place known no more, except to the philosopher, who can read in the rocks, the pebbles, the sand, and the trees, the records of the past. The watery sheet has given place to farms and villages, and the sound of the hammer, the axe, and the bell, is heard in the valley which once echoed with the shouts of the aboriginal, blended with the wild notes of the water-fowl.

The streams which pass through these prairies, though often large, flow with but little current, in a very serpentine direction, through a dark alluvial soil which contains but few pebbles, and no large bowlders. In many instances, a large vegetable growth, similar to that found in the neighboring ponds, arises from the bottom of the stream. Their shores are more elevated than the surfaces of the adjacent marshes, or prairies, and hence they are thickly covered by trees of a superior growth. The stately white elms, so abundant along their immediate borders, contribute much to the formation of a beautiful landscape. Their trunks seem to be placed at regular distances from each other, while their long branches meet and coalesce so completely, that they form a most extensive natural arbor. Early in the spring, multitudes of squirrels resort to them, from the neighboring hills, in order to feast on the expanding buds. Before the country was thickly settled, and the beauties of nature defaced by the hand of art, herds of deer might often be seen feeding on the undergrowth of these bottoms. At this period but few logs were found upon the surface. Occasionally a large prostrate elm, or sycamore, upon which a pheasant sat and thumped away the morning, pointed out the spot where the brawny squatter had feasted on wild honey, or labored to bring down a raccoon or a bear.

Wild fruits, especially plumbs, grapes, black and red haws, and black-berries, are abundant along the edges of wet prairies. In many places, in the vicinity of elevated lands, the ground is covered, for miles, with strawberries, but whether they are indigenous, or introduced by the very early settlers, I am unprepared to say. The blossoms of the crab, also, frequently fill the air, in the early spring months, with the most delicious odors. It is from these, together with the various other blossoms and flowers, that the wild bees chiefly obtain their honey. They usually store their sweets in the hollow limbs and trunks of the neighboring trees, where they sometimes accumulate immense quantities. But the most delicious fruit which grows in wet prairies, is the cranberry. The collection of this fruit furnishes occasion for pleasure parties of the young people, which are among the most agreeable of the rural diversions of the West.*

Many of the wet prairies are more elevated than those already mentioned. They are, however, small, containing but few acres, and distant from streams of water. Still their formation appears to be the same, with those already described. When ditched, the peat, which they contain, becomes very dry during summer seasons. A farmer once called my attention to a small boggy or shaking prairie, which had been ditched two or three years previously; but when the grass and small brush were set on fire, to prepare the ground for cultivation, the surface ignited, and continued to burn for the principal part of the summer. When the fire ceased, he found he had a bed of earthy ashes, from three to eight feet in thickness, instead of the productive soil he anticipated.

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* We have condensed into a single sentence a page descriptive of these excursions.—Ed.

Art. IV.—*Description of an Air Pump of a new construction, which acts either as an Air Pump, or a Condenser, or as both; enabling the operator to exhaust, to condense, to transfer a Gas from one cavity to another, or to pass it through a Liquid;* by R. Hare, M. D., &c. &c.

From the Transactions of the American Philosophical Society.

This pump has one iron chamber,* one piston, and four valves. When in operation, it is always simultaneously exhausting and condensing; and of course accomplishes as much in a given time, as two chambers of the usual construction, of the same calibre and stroke. A suction valve is placed at each end of a steel rod, which slides through the packing of the piston,† so as to be air tight, and to be pressed in opposite directions alternately. It is of such a length, that while it forces one valve, towards which the piston moves, against its seat, closing a corresponding aperture, it withdraws the other valve from its seat, and, consequently, opens the aperture with which this valve corresponds. Hence, with every reversal of the motion, the aperture previously opened will be shut, while that previously shut will be opened. Between the apertures thus alternately opened and shut, and the valve cock A, a communication is made by means of a forked leaden pipe, communicating with the valve cock at A, and with the apertures at B and C. The valve cock, by means of a gallows screw D, communicates, when desirable, with any receiver by another flexible leaden pipe P.

Two other analogous and corresponding apertures E R, which communicate in like manner with a valve cock G, are furnished with two valves opening outwards. These, when not subjected to any pressure from within the chamber, are kept in their places by spiral springs. They act as valves of efflux, and, like the valves in other condensers, are opened by the pressure of the air condensed by the piston as it approaches them, and are shut by the springs when the piston moves in the opposite direction. It is well known, however, that this mode of opening valves, if unassisted, always allows a small portion of condensed air to remain in that portion of the chamber and of the passage leading to the valve, which the piston cannot be made to occupy entirely. This disadvantage is diminished in the case of the valves which I am describing. A stem proceeding from each valve enters the chambers so far, as that the piston cannot finish the stroke without coming in contact with the stem, and moving the valve sufficiently to allow the air to escape, without suffering any resistance from the valve and its spring.

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* The diameter of the chamber in the instrument represented in the figure is three inches; the length is ten and a half inches, allowing a stroke of about eight inches, taking off the thickness of the piston. In order to render this instrument insusceptible of injury from mercury, it was constructed altogether of iron or cast steel.

† This contrivance was suggested to me by an excellent pump with glass chambers, obtained many years ago from Pixii. In that pump a steel rod is made to open and shut one valve: in mine the same rod opens and shuts two valves.

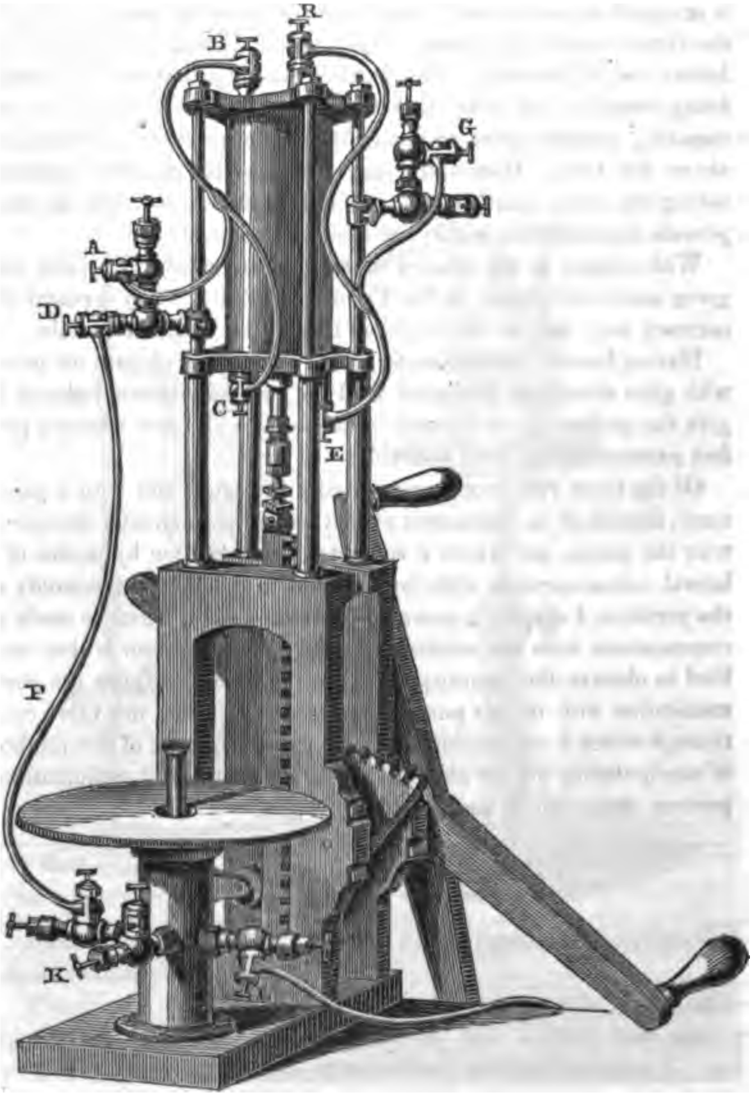
The means by which the apertures of the suction valves communicate with a valve cock A, and may be made to communicate with the receiver through the pipe P, have been explained. By like means the communication, existing between the apertures of the valves of efflux and a valve cock G, may be extended from this valve cock to any receiver. In fact, it is only necessary to vary the situation or number of the pipes, by which communications with the chamber are effected, in order to cause the apparatus to perform the part of an air pump, a condenser, or both. When employed to transfer air, it would be more correctly designated as a forcing air pump, than as a condenser.

The disk of brass in front of the pump, serves as an air pump plate, when connected with the pump by means of the pipe P, as represented in the drawing. It is supported on a hollow brass cylinder, furnished with valve cocks as at K L, in order to allow various experiments to be performed by means of the tube in the axis, surmounted by a cup of copper. The tube being open at the lower end, the cup is accessible to an incandescent iron. The contrivance facilitates the exposure of substances to heat, either in vacuo, or in any gas. When boric acid and potassium are thus heated, boron is evolved. By means of a similar arrangement, heating chloride of calcium with potassium, I obtained a potassuret of calcium, which decomposed water and yielded a solution which was rendered milky by carbonic acid.

When a glass globe of fifteen gallons is exhausted over this plate, and filled with oxygen gas, phosphorus having been previously placed in the copper cup, on heating the phosphorus, a combustion ensues of transcendent splendor.

For this and other experiments, the hollow cylinder, which supports the air pump plate, may be screwed into a hole in a table and placed at any convenient distance from the air pump. With this view, there is a conical screw cut upon the lower end of the cylinder.

Dr. Hare's Suction and Forcing Pump.



The mechanism by which the piston is moved, is too obvious to need description. There is, however, a peculiarity in the construction of the piston rod, which is of great utility. The rod is hollow, having been sufficiently reduced in diameter from a piece of gun barrel by the wire drawing process. The bore of this *hollow* rod is occupied by a solid rod, which extends from the metallic disk, at the farther end of the piston, to the rack. To the other disk, the hollow rod is fastened. The leather packing between the disks, being turned in the lathe so as to fit the calibre of the chamber accurately, is made more or less tight by the action of a screw just above the rack. Hence the pressure may be regulated without taking the pump apart, which is always troublesome, and at some periods impracticable within the time at command.

With respect to the efficacy of this pump, satisfactory proof was given some time since, at the Franklin Institute, when it raised the mercury very near to the height of that in the Torricellian tube.

Having been in possession for many years of an elegant air pump with glass chambers furnished by Pixii, we have been induced to give the preference to the new instrument, in all cases where a perfect exhaustion has been desirable.

Of the three valve cocks, one usually communicates with a gage; since, instead of an instrument of that nature permanently associated with the pump, and which is subjected to exhaustion by means of a lateral communication with the perforation leading to the cavity of the receiver, I employ a movable barometer gage, which is made to communicate with the receiver directly. The operator is thus enabled to observe the quantity of gas in the receiver, after the communication with the air pump is arrested by closing the valve cock through which it was established. An exemplification of this method of manipulating will be afforded by the apparatus and eudiometrical process, described in another article.*

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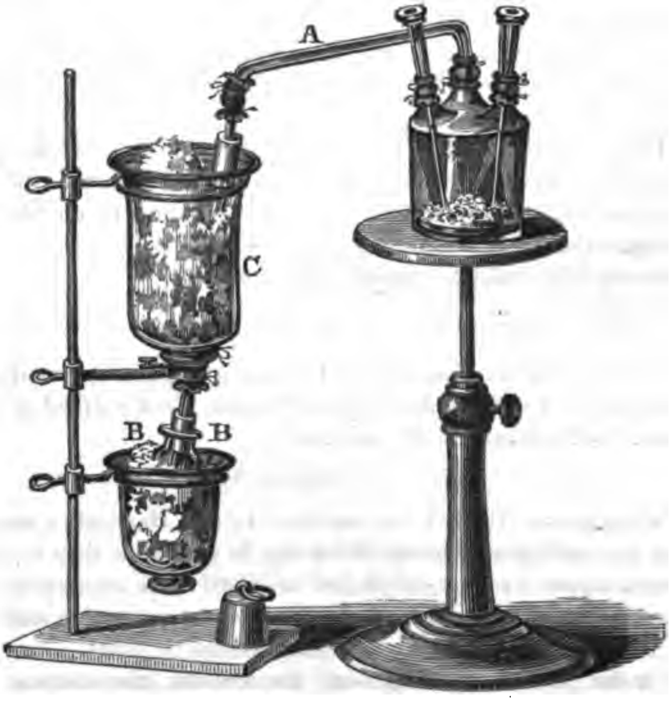
* See Vol. xxxii. p. 280, of this Journal.

ART. V.—*Process for Nitric Ether, or Sweet Spirits of Nitre, by means of an approved apparatus;* by R. HARE, M.D., &c. &c.

From the Transactions of the American Philosophical Society.

THE reaction of nitric acid with alcohol is so difficult to regulate, in the ordinary mode of making nitric ether, in which the whole of the materials are mingled at the outset of the process, that I was induced, about twelve or fifteen years ago, to introduce an apparatus in which they were gradually added together within a glass bottle, by means of glass funnels with glass cocks.



Subsequently I adopted the more simple apparatus represented in the accompanying figure.

Providing a bottle with three tubulures, let one tubulure communicate, by means of a recurved tube A, with another tube passing perpendicularly through an open-necked inverted receiver C, and entering a bottle surrounded with ice and salt, occupying a suitable vessel B B. The cavity of the receiver should likewise be occupied by a freezing mixture.

Into each of the remaining tubulures let a glass tube be introduced, ground or luted to fit air tight, and tapering so as to terminate in a capillary perforation near the bottom of the bottle.

Through one of the tubes introduce as much alcohol as will cover the bottom of the bottle, and then, by means of the other tube, introduce as much strong nitric acid as will cause an effervescence. Should the effervescence threaten to become explosive, the reaction may be checked by the further addition of alcohol, and when the reaction appears to decline too much, it may be re-excited by an additional quantity of acid. By these means, without applying heat, a quantity of nitric* ether will soon be condensed in the refrigerated bottle. To convert this ether into a liquid, fully equal to the officinal sweet spirits of nitre, let it be mingled with seven parts of alcohol and four of water.

The colder the freezing mixture, the greater will be the product; yet more or less may be obtained by refrigeration with cold water.

It may be proper to mention, that at the bottom of the phial an aqueous acid liquor is deposited, upon which the ether swims, and from which it should be carefully separated.

ART. VI.—*On the Cause of the Collapse of a Reservoir while apparently subjected within to great Pressure from a Head of Water;* by R. HARE, M. D., &c. &c.

From the Transactions of the American Philosophical Society.

IN September, 1834, I was requested by Mr. Haydock, a respectable and intelligent plumber of this city, to call at his shop in order to see a copper reservoir, which had collapsed while apparently subjected to internal pressure, arising from a communication with the mains proceeding from the public water-works.

For the purpose of refrigerating the contents, the reservoir was placed in spring water, at the bottom of a well, so as to be at a small depth below the surface; receiving the river water by one pipe, it was made to deliver it by another.

The pressure of the water with which the city of Philadelphia is supplied, is known to be sufficient, when at its maximum, to command the most elevated rooms in our dwelling houses. Hence, had the reservoir been burst, it would not have excited surprise; but the converse appeared inexplicable. The figure delineated below, will convey a correct idea of the reservoir as it appeared when I examined it; or subsequently, when a drawing of it was made at the Franklin Institute, to which it had been removed, at the instance of some of the members of that institution.

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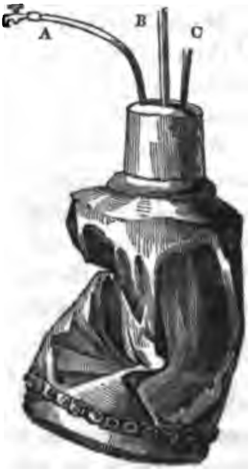
* The proper appellation of this ether being unsettled, I adhere to that generally used.



A, is a pipe with a stop cock to allow the air to escape on first filling the reservoir. B, a pipe by which a communication with the mains of the public water-works was established. C, a pipe for delivering the water.

The height of the vessel was three feet; greatest diameter eighteen inches, least diameter twelve inches.

Some days had elapsed, during which I was unable to offer any explanation of the phenomenon; but having mentioned the occurrence to another highly respectable and intelligent plumber, Mr. Ewing, he alleged that facts no less surprising had fallen within the range of his experience. He had known an opening made in a leaden pipe at one time, to be closed at another, by some unaccountable inward pressure; and, upon one occasion, a small fish to be caught in the fissure.

It then occurred to me that the phenomenon of the collapse had been the consequence of circumstances the inverse of those which are known to take place in the water ram of Montgolfier, in which water, while flowing rapidly in a trunk, being stopped suddenly in front, is made to produce a jet rising above the level of the head to which the current arrested is indebted for existence.

The momentum of the water which is in that case expended in a jet, must, in the case in which an arrestation takes place in the rear of a given portion of the stream, continue to propel that portion directly forwards, causing an hiatus or vacuum between it and the valve or cock by which the stoppage has been effected.

The inward pressure, or suction, arising from such a momentum, was demonstrated by Venturi;* and has latterly been ingeniously applied to the filling of syphons, and removal of back water from water wheels.

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* Nicholson's Journal, 4to series, Vol. ii. p. 172.

In this view of the subject then, we find the rationale of the collapse of the reservoir.

The current through the main being arrested at a point nearer the head than that from which the pipe supplying the reservoir proceeded, there was an hiatus produced within the main, and cavities therewith communicating, which caused the atmospheric pressure to be inadequately resisted, and consequently the reservoir, as one of those cavities, was crushed. No doubt the pressure of the spring water, in which the reservoir was situated, cooperated. At times our springs rise much nearer to the surface of the earth than at others.

When steam is made to pass through a pipe into cold water, a succession of expansions and condensations ensue, producing much noise and mechanical jarring, consequent to the alternate absorption and expulsion of the water. Agreeably to the rationale respecting the collapse of the reservoir, these effects should be productive successively of an inward and an outward pressure upon the surfaces of the pipes employed.

Some years ago, a pipe was submitted to me by Mr. Ewing, which, while situated as above described, had been crushed by a force which seemed to have exceeded any which could, under any circumstances, be expected from the pressure of the atmosphere. Possibly an adhesion between the water and the metallic surface, may cooperate in the production of such results.

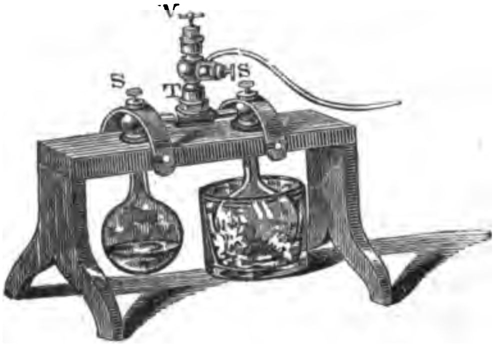
ART. VII.—*Sundry Improvements in Apparatus, or Manipulation*; by R. HARE, M. D., &c. &c.

From the Transactions of the American Philosophical Society.

Improved Cryophorus.

Two flasks, of which the necks have flanged orifices, are so secured in a wooden frame, that by the pressure of screws S S, and gum-elastic disks, the orifices of a tube are made to form with them severally, air tight junctures. The orifices of the tube are furnished with brass flanges, which correspond with those terminating the necks of the flasks.

Midway between the junctures a female screw is soldered to the tube for the insertion of a valve cock V, by means of which, and a flexible tube extending to an air pump, the flasks may be exhausted and then closed. A small quantity of water having been previously introduced into one of them, if, while the exhaustion is sustained, the other flask be refrigerated by ice and salt, the water will be frozen.*



The intelligent chemist will perceive that this apparatus may be applied to the purpose of desiccation by placing the article to be dried in one receptacle, and quick lime, chloride of calcium, or concentrated sulphuric acid in the other. The orifice of the receptacles may be made larger without inconvenience. Two large cylinders, for instance, may be used.

I propose, as soon as I have leisure, to apply the principle illustrated by this apparatus, to the distillation or desiccation of many substances which are liable to injury when exposed to heat or air. I conceive that there is, by means of analogous apparatus, a fruitful field for improvement in the arts. I conceive that it may be employed in the preservation of meat, milk, fruit, vegetables, and the making of cheese; also in pickling and preserving.

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* For the information of readers who may not be chemists, I subjoin the following explanation of the cause of the congelation of the water.

So long as no condensation is effected, of the thin aqueous vapor, which, when water is present, must occupy the cavity of the instrument, that vapor prevents, by its pressure, or tension, the production of more vapor: but when by means of cold the vapor is condensed in one bulb, its evolution in the other, containing the water, being unimpeded, proceeds rapidly. Meanwhile, the water becomes colder, and finally freezes, from losing the caloric which the vaporization requires.

According to Wollaston, one grain of water, converted into vapor, holds as much caloric as would, by its abstraction, reduce thirty one grains from 60° F. to the freezing point; and the caloric requisite to vaporize four grains more, if abstracted from the residual twenty seven grains, would convert them into ice.

Hydro-Pneumatic Cistern.

Fig. 1. In Silliman's Journal, Vol. xiv, p. 200, will be found an engraving and description of a pneumatic cistern, which I employed in the experimental illustrations of my lectures for more than ten years; and which I should probably continue to use now, had not the command of water from the public works, put it into my power to dispense with the mechanism for keeping the water at a proper level. As I am now situated, any deficit of water is easily supplied from the pipes known here as the hydrant pipes, by which the city is supplied with water; and any excess is carried off by a waste pipe. Many chemists designate as a pneumatic trough or tub, apparatus for the purposes to which that in question is applied. Neither of these names is, in my opinion, as applicable to the apparatus which I have hitherto used, as that of cistern, to which I resorted; and although the last term be less suitable to the apparatus which I am about to describe, yet I beg leave to adhere to it for want of a better appellation.

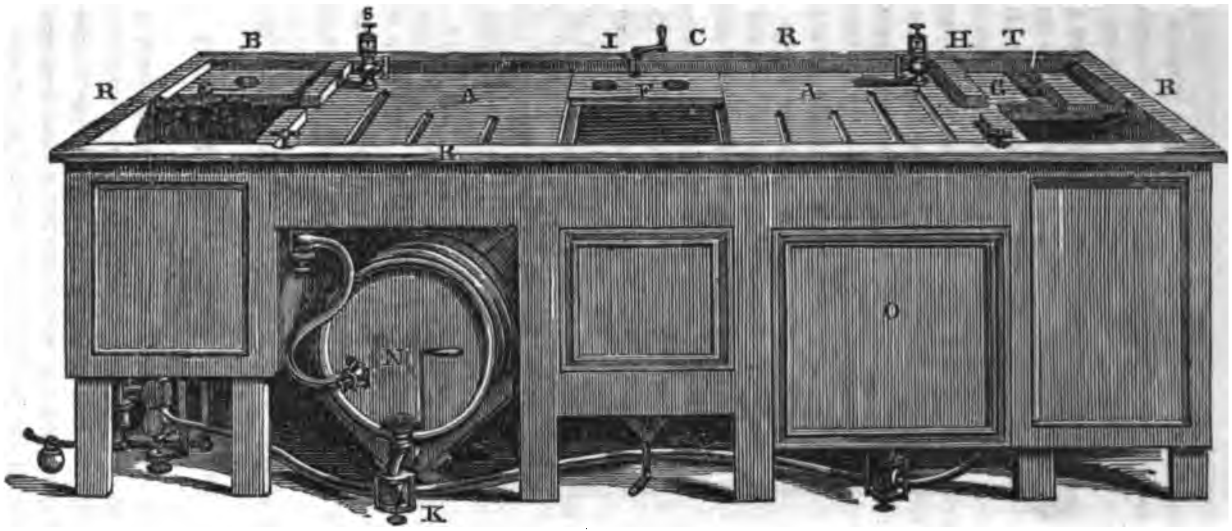
A A, a water tight platform, surrounded by a wooden rim, R R R R, rising above it about an inch and a half. B, C, D, three wells or cavities, each in the form of a hollow parallelopiped, with all of which the cavity bounded by the rim communicates, so that when supplied with water to the level of the waste pipe, this liquid fills the wells, and covers the platform to the depth of about three fourths of an inch.

E, F, G, shelves, which severally move in grooves over the wells, so that they may be placed in the most convenient position. Under H is a waste pipe. At I is a hydrant pipe. K, a pipe for emptying the wells and casks, with all of which it may be made to communicate by cocks, when requisite. N, O, casks which act as gas holders, each having a communication with the cistern at Q or *q*, for letting in water from that source; the orifices being controlled by valves. By means of a pipe proceeding from its vertex, each gas holder communicates with a pipe or cock, at S or *s*.

To these gallows screws, flexible leaden pipes may be attached, for transferring gas either from one of the holders to a bell glass, or from a bell glass to one of the holders. When a communication is established between the cavities, either of these offices may be performed, accordingly as the pressure within the holder is made greater or less than that of the atmosphere. It will be greater when the

Dr. Hare's Hydro-Pneumatic Cistern.

Fig. 1.



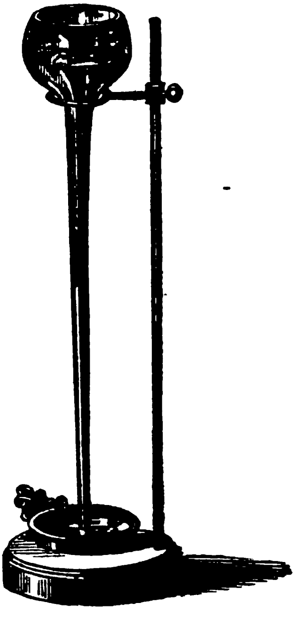
valve for the admission of water is opened, that for letting it out being shut: and less when these circumstances are reversed.

Fig. 2* affords a view of the lower side of the sliding shelf, in the wood of which it will be seen that there are two excavations, converging into holes. This shelf is loaded with an ingot of lead at L, to prevent it from floating in the water of the cistern.

Culinary Paradox or Ebullition by Cold.

This figure illustrates a new and instructive method of effecting ebullition by cold.

The apparatus consists principally of a glass matrass, with a neck of about three feet in length, tapering to an orifice of about a quarter of an inch in diameter. The bulb is bulged inwards, in the part directly opposite the neck, so as to create a cavity capable of holding any matter which it may be desirable to have situated therein. In addition to the matrass, a receptacle, holding a few pounds of mercury, is requisite. The bulb of the matrass being rather less than half full of water, and this being heated to ebullition, the orifice should be closed by the finger, defended by a piece of gum-elastic, and depressed below the surface of the mercury; the whole being supported as represented in the figure. Under these circumstances, the mercury rises as the temperature of the water declines, indicating the consequent diminution of pressure within the bulb. Meanwhile, the decline of pressure lowering the boiling point of the water, the ebullition continues till the mercury rises in the neck nearly to the height of the mercury in the barometer.



By introducing into the cup formed by the bulging of the bulb, cold water, alcohol, ether or ice, the refrigeration, the diminution of pressure and the ebullition are all simultaneously accelerated, since these results are reciprocally dependent on each other.

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* For this figure see Vol. xiv, p. 200, of this Journal.—Ed.

The advantage of this apparatus and method of operating, lies first in the certainty and facility with which the apparatus is secured against the access of the atmosphere; and in the next place, in the index of the diminishing resistance, afforded by the rise of the mercurial column.

Art. VIII.—*Notice of Oriental Minerals.*

1. By Professor F. Hall. 2. By the Editor.

1. By Prof. F. Hall.

A number of years ago, I received a box of minerals which were collected in Greece and the neighboring countries. For the collection and transmission of them I am indebted to my worthy friend, the late Rev. Pliny Fisk, American missionary to Palestine, who died at Beyroot, in Syria. The specimens were sent without names, but were all carefully numbered, and notice given, in most cases, of the places from which they were taken. The following remarks on them were prepared shortly after they came to hand, but, in the hurry of business, the paper was thrown aside, and never again came under my inspection, till a few days since. Thinking that the publication of it was due to the memory of the excellent donor, I take the liberty, sir, at this late period, to place it at your disposal.

From Sardis.

1. Milky quartz. A fine specimen—its aspect is slightly greasy.

2. "From the ruins of a church at Sardis." Calcareous breccia, composed of white angular fragments of carbonate of lime, held together by a calcareo-argillaceous cement.

3. Yellow quartz, or citrine, picked up "between Sardis and Philadelphia."

4. White granular marble—very beautiful, "from the palace in Sardis."

5. Grayish colored, disintegrating carbonate of lime, "from the market."

6. "From the walls of an ancient church." Marble sucrè, an elegant specimen.

7. "From a Corinthian capital in a church." Granular limestone.

From Pergamos.

1. Marble, made of compact limestone. "Broken from a pillar in the amphitheatre." It bears some resemblance to the Potomac breccia, but contains seams and thin veins of a blood-red color, produced, perhaps, by an oxide of iron; nitric acid dissolves it, yielding a brisk effervescence.

2. "Granite, taken from the walls of the same amphitheatre." The three ingredients which constitute granite, are all present, and well mixed, but strikingly different in color. The quartz is white, the feldspar a dull red, and the mica pitch black.

3. "From a statue in a castle near Pergamos." A rich, snow-white granular marble.

4. Granite, "from the castle wall." The feldspar is crystalline.

5. "From a Corinthian pillar, three feet in diameter, in the castle at Pergamos." It looks like the best Carrara marble.

6. Granite, similar to No. 2—"a common rock between Haivali and Pergamos.

From Smyrna.

1. Chalk, "picked up in one of the streets." Of a light gray aspect, a little soapy to the touch—is acted on violently by the acids, answers all the purposes of chalk, has on one side a little oolite, the *eggs* of which are harder than chalk, and some of them are hollow.

2. Jasper, of the finest quality; color red, fracture, when recently made, is resinous.

3. Concreted carbonate of lime, "near Smyrna," color dusky gray. A cylindrical cavity runs through its centre, which, it is probable, was once filled with some ligneous substance, now decomposed and absent.

4. Stalactite, "from the same place"—of a loose texture, and having several short branches.

5. "From the hill on which the castle stands near Smyrna." It is sienite. The feldspar is crystallized, and strongly resembles adularia.

6. "From Mount Sipylus, between Magnesia and Smyrna." Shining argillite, yielding a strong argillaceous odor when breathed on. Its color is bluish gray.

7. A beautiful specimen of calcareous spar, with argillite on two of its opposite sides. It is white and very brilliant.

8. Calcareous breccia, gray, porous, and containing angular fragments of argillite. "This," says the Rev. missionary, "is the common stone of Smyrna."

9. "From Mount Sypibus (or Sysibus) between Carrabar (or Canabar) and Magnesia, about twenty five hours N. E. of Smyrna. We rode two hours at the foot of a high mountain, composed of this kind of stone." A dark gray limestone, with seams of white calcareous spar.

From Ephesus.

1. A fine specimen of the *chaux carbonatée saccaroide* of Haüy, having a coarse grain, and somewhat of a pearly lustre.

2. Arragonite, connected with gray, granular limestone.

3. Common serpentine—color green, translucent at the edges.

4. Arragonite; it appears to have been a part of an ancient fluted column.

5. "From an Armenian burying ground near Thyatira. The date of the stone from which it was broken, was 1199." It is a compact limestone of a gray color, containing white veins of the same substance.

From Thyatira.

1. "From a hill near Thyatira." Compact limestone—has a smooth fracture, a little conchoidal.

2. "Near Thyatira." This is a singular product of the mineral kingdom. At first sight, I took it to be compact garnet, but soon perceived that its fracture was different from that of the garnet. It refused to give fire with steel. I applied to it nitric acid, and a copious effervescence occurred. Its color is a bright red, probably due to the oxide of manganese. In appearance, it resembles the Haddam manganesian garnet. It is, unquestionably, a carbonate of lime, and is partly surrounded by milky quartz.

3. "From a mountain between Pergamos and Thyatira, composed wholly of this stone, at the foot of which we rode four or five hours in a rich valley." Siliceous limestone of a light gray color, and yielding sparks with the steel.

4. "From an orchard of olive trees near Haivali." A white mass of calcareous matter, which seems to have been formed by art. It is, probably, an ancient cement.

5. Sienite, chiefly hornblende, "from the Haivali college."

From Philadelphia.

1. "From a wall near Philadelphia, which the people of the country say was built of men's bones. Some travellers are of the same opinion. Others think the stones of which it is constructed are petrifactions." Persons belonging to the civilized portion of the world will not long, it is to be hoped, remain so ignorant of the mineral kingdom as to allow them to place confidence on such ill-founded and foolish assertions. The substance in question is, *evidently*, a calcareous concretion, and much of it stalactical.

2. "From a tomb at Antipas." A specimen of coarse granular limestone.

From Cyprus.

1. A singular stone, part of a nodule, apparently rounded by water. The mass looks like uncrystallized hornblende, sprinkled here and there with small cuboidal crystals, having the lustre of metallic cobalt.

From Samos.

1. A good specimen of translucent arragonite of a whitish yellow color, in acicular crystals, radiating from three or four central points.

2. Greasy quartz, in which are a few specks of silver-white mica.

3. A mineral of a light green aspect, and very unctuous. It is a variety of talc. Its texture is fibrous, but the fibres are extremely minute, and crumble to pieces on being rubbed between the fingers.

4. Granular limestone of a sky-blue color, connected with partially crystallized calcareous spar.

5. Lepidolite, embracing thin layers of flesh-colored feldspar and a few half-formed crystals of the same substance. The lepidolite is pink-red, and composed of small scales.

6. Chlorite, soft, green, sectile—three specimens.

7. Fine grained siliceous sandstone, with minute veins of calcareous spar.

8. Quartz. Yields fire readily; a part of it white, and a part red.

9. Brown quartz, very compact and hard, differs little in appearance from the basanite.

10. Light-gray mica-slate, containing small spheroidal particles of oolite.

11. Disintegrating porphyry, comprising crystals of white feldspar, which crumble between the fingers—also rounded masses of the same substance.

12. Granular limestone, hard, and susceptible of receiving a fine polish.

13. Agaric mineral? Acted on by several of the acids—has nearly the whiteness of chalk.

14. A fragment of a beautiful red jasper.

15. Concreted carbonate of lime, belonging to the stalactitic variety, and broken, apparently, from the side of a stalactite.

16. Granular limestone, of a gray color, covered on one side with perfect triangular pyramids of dog-tooth spar.

17. Limpid quartz, with carbonate of lime.

The box contained twenty four specimens besides these, from the same island. Most of them were decidedly carbonates of lime, of the different varieties.

From Rhodes.

1. Calcareous matter deposited on a shell.

2. Reddish calcareous sandstone, evidently oolite, similar to the Portland building stone.

From Malta.

1. "Broken off from a column ten or twelve feet high, and in some places a foot in diameter." Manifestly part of an enormous stalactite.

2. "St. Paul's cave, three miles from Velletta." Light gray compact limestone, holding shells in different states of decomposition. It might perhaps be called *indurated marl.*

3. "Near the centre of the island." Much like No 2, except that it is friable. It answers for chalk, leaving a distinct mark on wood.

From Syra.

1. Magnetic oxide of iron, black and red. This is a rich ore, and might if it exists in sufficient quantities, be worked with profit. I have seldom seen an iron ore, which attracted the magnet more powerfully.

2. An aggregate of mica and crystallized hornblende.

3. Talcose slate, with a few particles of carbonate of lime.

4. This specimen resembles semi-opal, but is harder; yields fire more freely and abundantly. It is of a cream-yellow color, and porous.

5. Acicular hornblende, very beautiful; crystals irregularly arranged; some of them curved, and wearing a jet black aspect.

6. "From the ruins of a building belonging to the ancient capitol of Sira." Oolitic limestone of a reddish color.

7. Talc, green, indurated and filled with elegant flattened crystals of actynolite, very similar to those of the famous locality in Windham, Vt.

8. Mica slate, red on one side, and white on the opposite; a part of it resembles lepidolite. The whole is thickly sown with crystallized garnets, so much disintegrated that it is difficult to determine the number of their sides.

9. Mica slate, composed chiefly of layers of quartz and mica, the latter singularly contorted and twisted in every imaginable manner.

10. Magnetic oxide of iron, in small octohedral crystals, in chlorite.

11. Marble, white and fresh, as when taken from the quarry. "Broken from the statue of a woman."

From Egypt.

1. "Broken off from a rock near the pyramids. Some of the stones of which the pyramids are built are similar to this." Pisolite, a specimen as large as a man's fist, composed of particles of a lenticular shape, varying in size from a small pea to that of a walnut. These *lenses*, made up of thin layers of carbonate of lime, are hollow, or filled with sand, colored yellow.

2. "The common stone of the temple at Carnac, Thebes." A light gray, soft sandstone.

3. "A sample of the sarcophagus in one of the tombs of the kings, Thebes." Sienite; the feldspar is flesh-red, and the hornblende brownish, inclining to black.

4. A fragment of Pompey's pillar. "This specimen was given me by Capt. Skinner, of an English brig, who had been on the top of Pompey's pillar, and broke it off himself." Granite. The mica is black; the quartz white, vitreous, and sparingly distributed; the feldspar is red, and is the principal ingredient.

5. Granite, similar to No. 4. "Broken from the statue of Memnon at the temple of Memnon in Gornon, Thebes. The body of this statue, below the arms, is twelve feet in diameter from side to side; the arms four feet in diameter."

6. "Found on the banks of the Nile, a little below Tentyra, more than four hundred miles from the sea." Several specimens. It is a curious substance. It has the appearance of having once been an organized body, but to what species it belonged I cannot describe. Its description would occupy too much space. The different specimens are strikingly similar to each other in form, but unlike as to size. It gives fire reluctantly with steel, and is not acted on by the acids.

7. "From the mountains east of the Nile, near Minie." Gray siliceous carbonate of lime. It has, at some period, apparently been operated on by heat. On one side it seems to have been partially fused.

8. "From the temple of Carnac, Thebes." Jasper of an unusually resinous lustre. It yields sparks as copiously as any flint. Its color is red.

9. "The common stone of the mountains of Gornon, where are the tombs of the kings." A light colored, fine grained carbonate of lime.

10. Broken from a column in the Temple of the Sun at Balbec. Yellowish white granular limestone.

2. By the Editor.

Notice of Rocks, Minerals, &c.—from the Rev. Mr. Robertson, Missionary in Greece.

From the Island of Syra.

1. Beautiful aggregate of crystals of black hornblende, red garnet and epidote of a deep green; two pieces.

2. Quartz, tinged red and penetrated by crystals of epidote.

3. Crystallized hornblende, well characterized.

4. Crystallized actynolite, well characterized.

5. Deep green compact epidote, with distinct crystals of hornblende imbedded.

6. Talcose slate, well characterized; two pieces.

From Delos.

7. Summit of Mount Cynthus. Fine grained granite; quartz red; feldspar white; mica black.

8. Summit of Mount Cynthus. Granite with crystals of sphene.

9. Gneiss, not well characterized.

From Malta.

10. St. Paul's bay. Yellow calc-spar.

11. Catacombs of Malta. A beautiful soft tertiary limestone, with shells.

From the Island of Milo.

12. A beautiful soft tertiary limestone, with Pectens.
13. Obsidian, good; a pebble.
14. Sandstone.

From Santorini.

15. White trachyte, with specks of black mica; strong marks of fusion.

From Paros and Antiparos.

16. Calc-spar, very good.

From Eubœa.

17. Red jasper; near Chalcis.
18. Mass of quartz, with garnets; near Chalcis.
19. Compact deep green talc; near Chalcis.
20. Compact deep green epidote; near Chalcis.
21. Hornblende rock; near Chalcis.

From Athens.

22. Red porphyry.
23. Red calc-spar.
24. Red compact limestone. Mars Hill.
25. White saccharoid limestone. Parthenon.

From Tenos.

26. Compact deep green talc; same as 19.
27. Epidote, crystallized in quartz.
28. Serpentine, golden yellow color, with dark spots, probably chromiferous iron.
29. Mass of epidote, garnet and quartz.

From Smyrna and Gulf of Smyrna.

30. Calcareous deposit in distinct layers, two inches thick, like stalactite, nearly filling an ancient water pipe, made of baked earth resembling tiles: a portion of the pipe four inches long still remains attached to the deposit, and retains its form curved.
31. Siliceous deposit in distinct layers; near Vourla.
32. Compact limestone. Sahib Island.
33. Dark porphyry. Sahib Island.
34. Porous inflated lava. Sahib Island.
35. Brittle lignite. Sedicui.

From Elba.

36. Granite; feldspar white; quartz gray; mica black. Whole island said to be of the same rock.
37. Granite, with garnets.

ART. IX.—*Meteoric Iron.*

1. *In Texas.*

In Vol. viii. p. 218 of this Journal, is an account of the great mass of meteoric iron from the Red River, now in the cabinet of Yale College. Among almost forgotten files we find a letter, dated Sparta, Tennessee, Sept. 15, and another, dated Oct. 17, 1829, from Robert Cox, to the editor, containing the following statements.

A gentleman returned from a five years' absence in the province of Texas, during which time he had been frequently with the Camanche Indians, and a small party of them conducted him to a mass of metal lying on the bank of a creek. Its length was four feet, and it was about one foot square [at the end.] It required six of the Indians to raise it on end. A piece weighing two ounces was cut off by a tomahawk. It possessed great hardness and tenacity, and when hammered (in the cold) shewed great malleability, being easily beaten out very thin without cracking or scaling. The color was stated to be between that of gold and silver. Its lustre was remarkable, and could not be tarnished by any thing that was done to it, even by the application of heat. The large mass of metal seemed to defy every attempt to make an impression on it, except under the hammer, when it became pliable and soft. From the acquaintance which we have with the large mass alluded to above, we cannot doubt that the piece described in Mr. Cox's letters is nickeliferous meteoric iron. Those that saw the piece were disposed to make it out to be gold, and probably saw a yellow tint quite as strongly as it existed, if indeed it existed at all, for the malleable iron which we have from the same region is like that of Siberia, of a remarkable pure grayish white, with a high degree of lustre.

We have recently seen a gentleman, who stated that he knew of several large pieces of malleable iron in Texas, and we hope to obtain some more precise information concerning them.

2. *Meteoric Iron in France.*

The late Col. George Gibbs brought to this country some pieces of meteoric iron which he detached from a large mass lying on the mountains of Auvergne in France, and a notice of it was published in Dr. Bruce's Journal of Mineralogy, in connexion with one of the Louisiana iron.

The following extract is taken from a letter addressed to the editor by Mr. Wm. C. Woodbridge, the well known geographer, and dated Paris, Aug. 29, 1829.

"In passing through Bonn, upon the Rhine, I visited Professor Noeggeratti, a distinguished mineralogist of that university. He spoke with great interest of our efforts in reference to mineralogy, and especially of the American Journal. He observed to me that, singular as it was, he had received through that Journal the first account of an interesting fact in his own neighborhood.

"He had heard many years since of a large mass of iron lying on one of the mountains termed 'the Seven Mountains,' in this vicinity, but which was supposed to be a remnant of an old furnace. He designed to examine it, but delayed from time to time, and at length heard that a foreign officer had been there and taken away a large portion. He thought little more of it, until some time after, when he saw in the American Journal of Science, Col. Gibbs' account of his discovery of a mass of meteoric iron on this very spot. He immediately went to examine the fact: he found that the mass had been cut up and put into the forge, but the smiths not having skill to work it, it was again thrown aside, and lay buried under a heap of scoria. Prof. N., after some search, discovered a very large quantity of this iron, and verified the existence of nickel, and the truth of the account which the American Journal* had been the medium of announcing to the world, of one of the largest masses of meteoric iron yet discovered."

Art. X.—*On Natural Magic;* in a letter to the Editor.

The theory of accidental colors, so ingeniously developed by the successive labors of Scherffer, Epinus and Sir David Brewster, has been alluded to by the latter, in his treatise on natural magic, as probably adequate to account in some instances for spectral illusions, but for such only, in his opinion, it would seem, as may occur in full day light. Observation, however, has assured the writer, that appearances of this kind are not so peculiar to the strong light of day, nor so rare as seems to have been supposed.

The retina of the eye, by the action of light upon it, has its sensibility weakened, which it will again recover completely, in the absence, or partially by the mitigation, of this action. When therefore one keeps his eyes for a time directed to a portion of black surface surrounded by white, the sensibility of all that part of the retina on which the white surface throws its light, is weakened in a much higher degree than that which is occupied by the image of the black portion. Then on turning off the eyes to a quarter from which light comes nearly uniform, the effect on this now most sensitive portion, is contrasted with the slighter effect produced on the surrounding parts, and there appears to the observer, as it were, an image of light, in shape and size like the portion of black surface before viewed.

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* We are inclined to think that the account here referred to, must have been that originally published in Dr. Bruce's Journal.

Now the *relative* amount of light reflected from white and from adjacent dark surfaces, is probably the same, whether the incident light be feeble or strong, and consequently the *relative* strength of their respective impressions on the retina is also the same. And indeed the eye, especially if it has been for some time previously in the dark, seems to be not less sensible to this difference of impression in a twilight than at noonday, provided the darkness be not too great, so as to render all objects nearly alike obscure. But however this may be, the appearance of ocular spectra in such fainter light, is favored by the fact that the attention does not then, owing to the partial obscurity in which the substantial objects before us lie, so readily and so almost unavoidably fix itself upon them, which if it should do, any image that may remain impressed on the retina is not regarded, for the mind it seems cannot attend to two things at the same time. Another reason why such phenomena are so seldom noticed by individuals who do not purposely take the preliminary steps necessary to produce them, is that the eye is usually a restless organ, rarely dwelling upon the same part of an object for more than a few minutes at a time. The design and effect of this is, on a compensating principle, to prevent the formation of any impressions of such a character as to be inconveniently permanent or embarrassing to our vision. This propensity to wander is, however, sometimes overcome, and the occasions when this may happen are various.

A day or two since, listening to a public speaker at such a distance, that, to catch his words I found it necessary continually to watch his lips, I at length cast a look towards the expanse of white ceiling beyond him, and saw a white picture clearly representing him, wherever I turned my eyes. The propensity before adverted to, is more commonly subdued involuntarily by grief, as for the decease of a friend. If in consequence, by the accidental presence before the eye of a proper object, or a suitable combination of light and shade, a spectral appearance is then produced, (it being supposed now partially dark), a superstitious person might very readily be led, with a little aid from imagination, particularly as the idea of his departed friend is now uppermost in his memory, to believe strenuously that he had seen the ghost of the deceased. The child who goes alone at dusk is prone to watch any *black* object, especially if it is made conspicuous by a prevailing whiteness of the objects about or beyond it. We can easily see how, on his looking round, his young imagination may, and not without a cause, be startled into a troublesome activity.

The writer well remembers with what sensations he has in childhood watched the spectres that on moonlight nights used to haunt the black garments hanging upon the white wall of his apartment. Any one may observe such phenomena very favorably on waking at dawn, by fixing the eyes for a considerable time (one minute or even less will suffice for an experiment) steadily upon a dark colored object projected or situated on a white or whitish ground, and then looking off towards the white ground, when directly he will perceive a white representation of the object he has been viewing, either upon the white ground, or between it and himself, according to his fancy. One can make it, when it is of a middling brightness, disappear and again reappear, by simply giving his attention for a moment to something beyond, and then again to the image. If the eye has been kept constantly upon the same point of the dark object previously viewed, the white image of the latter will be a distinct and faithful representation. Otherwise it will be varied, and might by a startled imagination be easily conjured into the most frightful shapes. If a person is at twilight travelling towards a hill (or even a level space) covered with snow, and steadily watches another person in a dark dress, advancing a short distance before him, whose figure is projected towards the snow, he sees on looking aside, a white spectre in human shape. It will in some instances appear to be roving, the observer all the time thinking that he follows it with his eyes, while in fact it depends for its motion upon this same movement of the eyes. Should it, before it fades into obscurity, arrive before some dark retreat, it there vanishes, for its appearance depends upon the light coming from objects beyond it. A result similar to those already described, might surprise a person who looks up, after having for some time gazed down upon the path he is walking in, the black soil of which is strongly contrasted with the bleached grass on either side.

Whoever will attentively watch the operation of this principle, in experiments which he can make almost any where and with very little trouble, will, we think, be abundantly satisfied that it must have acted no inconsiderable part, in keeping alive those superstitious impressions which in former ages have been so generally prevalent, and that it is the talisman which raises some at least of the apparitions that are occasionally alarming the young and the superstitious, at the present day.

S. Q. P.

New Haven, March 8, 1837.

Art. XI.—*Meteorological Sketches.*

(Continued from p. 65.)

Of Deserts.

The atmosphere is capable of absorbing aqueous vapor in proportion to its temperature, and as a current of air in passing from a colder to a warmer region necessarily increases in temperature, it thus acquires an increasing capacity for moisture, which tends to prevent the formation of clouds and rain. This condition pertains not only to currents which descend from high mountains and sweep over elevated plains, but is peculiar to a certain section or portion of the great natural circuits of wind which are found in various regions, on both sides of the equator. The necessary consequence, is a scarcity of rain in this portion of the aerial current, or in those places where the winds from the temperate or extra-tropical latitudes are found blowing towards the equator, either uniformly, or for regular and determinate periods. We perceive here the principal cause of those arid deserts, comprising almost every variety of geological formation, which occupy so large a space in the otherwise most fruitful latitudes.

On examining the map of the world, it may be seen that this absence of rain is found chiefly in countries lying between the 18th and 32d parallels of latitude, and situated upon the eastern side of the great oceans or of the great circuits of wind which are found to prevail in the temperate and lower latitudes. On the western shores of the Atlantic, in North and South America, where the aerial current is passing from the equator towards the higher latitudes, we find on the other hand that there are adequate supplies of rain. The same is generally true of the western shores and islands of the Pacific ocean; and the *westerly* monsoons being of this latter character, generally afford copious rains, while the easterly monsoons, or regular trade winds, which incline towards the equator, are equally remarkable for their dryness, at least within the latitudes above mentioned.

In the atmospheric basin of the North Atlantic, we have the most striking exhibition of this effect in the great African desert of Sahara. Continuing our survey eastwardly under the same parallels, we find also the great deserts of Lybia, Egypt and Arabia, which for the most part are subject to the same course of general winds, the blighting effects of which fully exemplify the position which is here assumed. In the atmospheric basin of the South Atlantic, we find also, in South Africa, an arid region, extending across the same parallels of latitude, where a southerly wind is found to prevail, which in its progress towards the equator, becomes merged in the southeast trade-winds. The same effects are produced on the eastern shores of the Pacific ocean, where, upon the coasts of Chili, Bolivia and Peru, we have a like section of the general winds, which, notwithstanding the near proximity of the Andes, causes the desert of Atacama, and a remarkable absence of rain on other parts of the same coast. The same general effect is produced by the corresponding winds which prevail upon the western coast of North America, where, owing to the peculiar direction of the sea-coast and mountain ranges, the arid influence is extended, as in some parts of Asia, far into the temperate latitudes. The phenomena attending the general winds in the basin of the Indian ocean, and New Holland, are of the same character. It seems to follow, that the general sterility, or periodical drought of the regions referred to, is not to be ascribed to the peculiar constitution or composition of the natural surface, or to excessive heat, but must be attributed to the peculiar *course* and the consequent hygrometric condition of the general winds which there prevail.

Of the Variations of the Barometer.

The fluctuations in the height of the mercurial column have long excited attention, and the proximate causes of these changes are deemed, by late European writers, to be as yet unknown. These fluctuations of the barometer appear to differ in their character and origin, and may be classed under the following heads.

I. *The regular semi-diurnal oscillation, which in the tropical latitudes is at its maximum from* 9 *to* 10 *A. M., and at its minimum about* 3 *P. M.* In the temperate latitudes, the effect appears to be nearly the same; but Professor Forbes has shown that in very high latitudes the effect is reversed, the minimum being at 10 and the maximum at 3 o'clock. This oscillation appears to indicate a system of atmospheric tides, resulting from the rotation of the earth and its relations to the solar system.

II. *The more striking and irregular variations which attend the presence and passage of storms of wind, especially in the higher latitudes.* This class of fluctuations is believed to admit of an easy and satisfactory explanation.

It appears from a careful examination of the phenomena of hurricanes and storms, as they occur in various regions, that the greatest depression of the barometer is found within the body of the storm,—that this depression constantly accompanies the storm during its progress from one region to another, notwithstanding the tendency of the air to move from all sides towards the point of least pressure,—and that the wind in these storms is found to blow in a lateral or circuitous direction, around the point of greatest depression, which is near the geographical center of the storm. Now when these facts are considered, it becomes evident that the centrifugal action of the air in this powerful rotative movement, effectually opposes the gravitating tendency towards the point of least pressure, and thus maintains, mechanically, the constant rarefaction which causes the depression of the mercury under the storm. Were it possible to produce a movement of the wind from all sides of a storm, in the direction of its center, the depression of the barometer would at once be terminated, and an accumulated pressure would immediately take place.

A demonstrative proof of our position is also found in the barometrical depression which is so constantly exhibited in the permanent atmospheric eddy at Cape Horn and the Strait of Magalhaens, which is caused by the westerly winds that press upon the Cape and are disgorged into the Southern ocean around the southern termination of the Andes. Capt. P. P. King, who surveyed this region and who was furnished with the best instruments, adjusted to the standard of the Royal Observatory, informs us that the mean height of the barometer was about 29.50 inches; and a register of the observations for seven months from February to August, inclusive, at the observatory at Port Famine, in the Strait, shows a mean of 29.43 inches. This result is confirmed by the observations of other officers; and may serve, also, to show the error of Mr. Daniell's position, that the mean pressure of the atmosphere during the year, at the level of the sea, is every where the same.

III. *The constant or periodical accumulation of atmospheric pressure, which arises from natural obstacles, opposed to the course of the general or trade winds; and the corresponding depression of the barometer, which results from the retardation of such winds by like obstacles or by an unnatural and forced route, in their progress towards the point of observation.*

The most remarkable variations of this character are found under the eastern and western monsoons, in Asia and the Indian and Pacific oceans. The N. E. monsoon or regular trade wind, obstructed in its natural course of deflection from the tropical to the temperate latitudes, by the great Asiatic elevations, is forced to continue a sluggish course across the equator, into the N. W. monsoon. The effect of this resistance in raising the barometer is such, that at Canton, in China, the mean height of the barometer during four months of the N. E. monsoon, for a period of seven years, has been found to be 30.20 inches. The mean height during four months of the S. W. monsoon, owing probably to the tardy passage of the S. E. trade from which it is derived, in its unnatural course across the equator, being, for the same period, only 29.86 inches.

IV. *The oscillation of an extensive region of atmosphere in the higher or temperate latitudes, causing a rise of the barometer of some days or even weeks continuance; and a corresponding depression for like periods at other seasons.* These extensive oscillations may, perhaps, be referred to the alternately predominating influence of gravitation toward the poles, and the counter force of the centrifugal action of the earth's rotation towards the equator, aided probably, by some of the other causes to which allusion has been made.

Although storms of wind, from the manner of their development, usually produce rain in some portion of the area which they occupy, yet the fall of the barometer, being chiefly dependent on mechanical causes, has no necessary connection with the fall of rain. It appears from the observations of the Marquis Poleni, that in one thousand one hundred and seventy five instances of the fall of rain the barometer sunk only seven hundred and fifty eight times, being six hundred and forty five to one thousand. In the United States the most copious rains not unfrequently occur during an unusual elevation of the barometer. R.

Art. XII.—*Seventh Meeting of the British Association for the Advancement of Science*—Liverpool, Saturday, Sept. 9.

The report of the doings of this meeting, (appropriately called by one of the speakers her majesty's parliament of science,) with a *condensed* abstract of most of the papers, fills fifty six pages of the London Athenæum, equivalent to about three hundred of this Journal. When the papers, or so many of them as may be thought worthy of that honor, shall be printed in full, it is easy to see that they will occupy a large volume, which, should the Association be fully maintained, will continue to form an annual contribution, of no small value, to science and the arts, several volumes of which have already appeared.

It is impossible, consistently with our limits, and with the obligations due to many persons and subjects, to do any thing more than cite from the printed reports of the Athenæum and of the Liverpool Standard and Mercury and other British papers received from valued friends abroad, some leading facts presented in the form of excerpts, and it may be with little connexion. In doing this we shall be obliged to pass over entire subjects, and which very possibly may be, in particular cases, more important, at least in the view of some of our readers, than those which we select.

The meeting was fully attended; many distinguished men were there, although others whose names we have been accustomed to see on these occasions were absent.

Magnets.—Mr. Cunningham, to try the efficacy of cast iron in forming magnets, "got three small castings made of the horse-shoe form, each weighing seven ounces; on touching these with a small compound magnet in the usual manner, he was very agreeably surprised to find them absorb and retain the magnetic influence in a degree superior to any steel ones he had ever previously constructed; and stated, that he had no doubt that they would be further improved if beaten red hot and very slowly cooled, which would make the metal softer, and the grain more uniform, and they might afterwards be hardened at the poles to produce the maximum effect. He considered this result of much importance, as it will enable us to construct compound magnets for magneto-electrical machines with great facility, and at a very trifling expense, as any number can be cast from one timber pattern."

"Mr. Holden said, that he had bestowed much time and attention on the construction of magnets. He preferred steel tempered blue, or to spring temper, and was on the whole, inclined to doubt the value of the material proposed. He knew that cast iron was capable of receiving strongly the magnetic influence, and bars of cast iron, as long as they retained their upright position, were found to possess polarity in a very high degree; but he doubted whether, if they were removed from their upright positions, they would long retain their polarity to any considerable extent."

"Mr. Snow Harris observed, that from many trials and much experience, he was convinced that hardened steel wire, just as it is to be had in the shops, without any further working it, or putting it into the fire, or altering its temper, was the best material for constructing small needles, intended to retain their magnetism permanently; and this latter consideration was of the utmost consequence when constructing needles for philosophic research, as, for instance, upon the magnetic intensity at various places, since the slightest alteration of power, in that case, would most materially and injuriously affect the result."

Mr. Scoresby preferred evenly tempered steel such as watch springs or ladies' busks.

Prof. Henry had tried cast iron and found it did not retain its magnetic power.

Tides.—"By a fortunate circumstance, the preservation of a register of the tides, kept for a short time during the 13th century, at London Bridge, by an abbot of St. Albans, John Wallingford, and which register had been preserved in the British Museum, it had had been clearly shown that the establishment for the port of London varied since that time by a quantity extending to between two and three hours: the cause of this could be as yet merely conjectured."

Iron.—On the use of Anthracite coal by the combination of heated air to the purpose of smelting iron ore.—"The reduction of the quantity of fuel expended to less than a third of that before required of the bituminous kinds for the production of one ton of pig iron, the increase of from forty to fifty per cent. upon the former, make by this process, and the increased strength of the metal, when compared with that before obtained by him from the native ores of the South Welsh basin, with the use of the coke of the bituminous veins and cold blast, were the leading points of the paper. Mr. Crane dwelt on the abundance of this variety of fuel, of which there are large deposits in Wales, Scotland, Ireland, Sardinia, France, Transylvania, and particularly America."

On the Crystallization of Metals by Galvanic Influence.—The Secretary then read a paper, by Mr. Golding Bird, 'on the crystallization of metals by galvanic influence.' To this department of knowledge popular attention has been peculiarly attracted by the well known experiments of Mr. Crosse, detailed at the last meeting of the British Association at Bristol; and it is in connexion with this gentleman's experiment that the present paper is more particularly interesting. It has long been a matter of extreme interest and importance to connect those changes constantly going on in the physical world with those which are observed in the laboratory of the chemist; to compare the researches of the experimental philosopher with the effects every where produced in the vast amphitheatre of nature. With this view the experiments about to be detailed were undertaken. Philosophers have long been accustomed to attribute the formation and crystallization of metals in mineral veins to voltaic action, but this could be regarded as little else than a matter of assumption until some experiments actually supported this point of view. To M. Becquerel we are mainly indebted for the knowledge of the power of a single galvanic circle in producing powerful voltaic decompositions, whilst to our own countryman, Dr. Faraday, we owe that most important piece of information, that poles, or *attracting surfaces*, are by no means requisite to the crystallization of a metal, and that all that is necessary for the reduction of a metal from a salt or oxide is the mere passage of a voltaic current. That this current may be of the weakest intensity has been shown by Dr. Bird in an essay lately read before the Royal Society of London. The apparatus contrived by Mr. Bird was very simple, consisting of an external cylinder of glass, capable of holding about half a pint of fluid, filled with a solution of common salt, (chloride of sodium;) into the contents of this cylinder was plunged a second and smaller cylinder, furnished at its lower extremity with a plug of sulphate of lime: this second glass cylinder was filled with a solution of sulphate of copper; into the latter a plate of copper, furnished with a conducting wire, was immersed, whilst into the solution of salt a plate of zinc, also furnished with its conducting wire, was plunged. Under these circumstances, a current of electricity is developed, the plate of zinc becoming positive, and the plate of copper negative, although the *intensity* of the current could be scarcely supposed sufficient to the production of chemical action. Mr. Bird has however shown, that when the connecting wires of the two plates of this elementary battery were immersed in a saline solution of a compound salt, the most important physical and chemical changes were produced; and that if, instead of immersing these wires in fluids, they are twisted together, so as to insure metallic connexion, it will be found that the electric current developed will produce most interesting and unexpected effects on the metallic solution present in the smaller; for although, it might be anticipated that the copper would be reduced, yet we should expect that this reduction would be most obvious at the surface of the negative electrode, which, however, Mr. Bird has shown not to be the case; for on examining the plug of sulphate of lime, (plaster of Paris,) closing the smaller cylinder, and separating the solution of sulphate of copper from the brine, it was found that beautiful and hard crystals of metallic copper were deposited in it, not in a confused manner, but in veins precisely resembling those met with in mines, of which, however, it is scarcely necessary to observe they presented but a miniature resemblance. From this, it appeared, that the *mere passage of an electric current*, independent of the presence of poles, was sufficient to effect metallic reductions, supporting in a satisfactory manner, the experiments of Dr. Faraday on this subject. The metallic crystals thus obtained were very hard and brilliant, resembling in a striking manner those produced in the vast theatre of nature, indeed, some specimens exhibited by Mr. Bird, obtained by the aid of his miniature apparatus, precisely, and, indeed, so closely resembled the most perfect forms of native and ruby copper ore, that they would probably defy the most expert mineralogist to discover their true origin. These effects were, moreover, by no means confined to salts of copper; for, when solutions of antimony, lead, tin, zinc, bismuth, silver, or other metals, were placed in the inner vessels, instead of a solution of copper, the metals were, in every case, reduced, partly on the plate of copper which served for the negative electrode, but chiefly in crystals imbedded in the mass of plaster of Paris closing the inner cylinder.

Other experiments, bearing upon this subject, were also detailed, which it is unnecessary to mention. They with those already noticed, were considered interesting in explaining the cause of the depositions of metals in veins; for, as the magnetic theory of Arago, Ampere, and others, requires that free currents of electric matter should be perpetually circulating around our earth in a direction at right angles to the magnetic meridian, so these currents, instead of merely causing the evolution of magnetic phenomena, are shown to be sufficient to produce most important chemical changes, causing, by their passage through masses of clay or earthy matter, the reduction and crystallization of the metals diffused through them in solution. To one circumstance, Mr. Bird particularly called the attention of the meeting, viz. the danger of considering the chemical changes produced in the bowels of the earth as in the first place depending upon metallic veins themselves; for, although it was evident that by the action of heat upon them, thermo-electric currents may be, and no doubt are, developed, yet we must regard the first physical cause which induced the deposition and formation of these very veins; and this cause, it is evident, can be none other than, in the first instance, chemical action. Upon this point, Mr. Bird's experiments, in conjunction with those of Dr. Faraday and M. De la Rive, are certainly interesting, as throwing light upon that most obscure of subjects, the formation of metallic veins in the bowels of the earth.

A valuable part of this communication appeared to us to be, that in which Mr. Bird suggested that the silification of wood is an electrical phenomenon. He has undertaken experiments to test this theory, and we are happy that so interesting a subject of inquiry should be in such competent hands.

Sediment.—The proportion of insoluble matter contained in the Mersey, amounts to twenty cubic inches in the flood, and thirty three inches in the ebb, in each cubic yard of water; evincing a preponderance of one in eight in the matter of the ebb, or 48.065 cubic yards of silt, &c. which is detained by the banks outside the Rock Narrows each tide, with the exception of what the succeeding ebb disturbs, at the exhausted stage of the former ebb. Thus, the ebb of to-day ranges over sixty four square miles, and the next ebb over forty four square miles, reducing by one third the first day's layer, that being the relative proportion of silt held in solution, and deposited over the outer area, at the northern margin of which the cross set of the Irish Channel ebbs, limits the deposit by sweeping into broad water what may extend so far. Now the excess of silt, on the seven hundred and thirty refluxes of tide that occur in a year, amounts to thirty five millions eighty seven thousand four hundred and fifty cubic yards, capable of spreading a layer, if equally disseminated, of twenty one inches thick over the first tide area; one third however is disturbed, and carried over the second tide area; or there is an uniform increase of the banks, and decrease of water in the channels of the estuary of the Mersey, amounting to seven inches per annum. This deposition of matter is however very unequal, some parts of the coast and of the banks receiving great accumulation, while others are often taken away. At the quarantine ground, the bed of the river shoaled up twenty two feet in eight years, and then eleven feet in two years, over a space of half a mile long by one quarter of a mile wide, and yet this was swept away in eighteen months. Captain Denham had been examining the port of Liverpool for fourteen years, and he infers from his observations, that a time will arrive when no access to this port could exist, unless man set bounds by his ingenuity, to the operation of tidal action. He made a number of local observations, which showed the diligence he had exercised in both planning and executing whatever he conceived might benefit this most important port; and he finished by an explanation of his principle of a constant sea level, which he had ascertained to be at three hours before, or three hours after high water, and by exhibiting the instrument which he had employed in drawing up water from different depths.

Fossil Plants.—The President called on the Rev. Mr. Yates, who exhibited to the section some interesting remains of fossil vegetables found in the new red sandstone of Worcestershire. He mentioned the discovery of similar remains in the same formation in other parts of England, as at Coventry, where trunks of trees, of a considerable size had been found; and stated that in the Royal Institution of Liverpool is preserved a fossil trunk found in excavating Prince's Dock. The specimens laid before the section were from two quarries between Worcester and Ludlow, one in the parish of Stanford, and the other in Ombersley; the former being where the new red sandstone joins the Silurian rocks. In this quarry the stone is rather greenish, like coal sandstone, and not unlike the Keuper of the Germans; but it may be traced in a line about ten miles, into sandstone of the usual red color. In the second quarry branches of trees have been discovered, and trunks partly converted into coal: each trunk seems imbedded in a cylindrical mass of ferruginous matter. Through this quarry, a trap dyke passes, altering the rocks on each side. A specimen of the metamorphic rock encrusted by chabasie was exhibited. The general appearance of the quarry led Mr. Yates to the conclusion that there had been a deposit formed by a current near the shore of a sea, which deposit had been fixed in a bay or recess where the remains of vegetables lay without being disturbed; and he alluded to the banks at Liverpool, where scarce any drifted plants had been discovered, owing to the continued motion of the currents, while they might be found in coves along the shores where the water was less agitated.

Impressions in sandstone.—The Rev. Mr. Clarke exhibited specimens of vegetable remains inclosed in new red sandstone from America transmitted to him by Prof. Hitchcock, who discovered the marks of the steps of birds in this rock a short time since. In a letter to Mr. Clarke, the Prof. has notified further discoveries of these singular steps, and also the remains of Saurians in this formation. In graywacke he had also discovered the remains of Marsupial quadrupeds.

Argas Persicus.—W. S. Macleay in the chair.—Dr. Traill exhibited a specimen of the *Argas Persicus*, or poisonous bug of Mianneh in Persia, giving a short notice of its effects. In some parts of Persia it is the prevalent belief that this animal not only produces fever, but often death from its bite. It is not a true insect, but belongs to the order Arachnidæ, and to the genus Argas, from which it was separated by Lamarck. Two districts in Persia are largely infested with it, and it is reported that to sleep exposed in these is certain death.

Dr. Bell, a resident, had never known a case in which death was produced, but had seen persons extremely ill from its effects.—The Chairman doubted whether there was sufficient authority to believe that the bite of the insect was mortal, and ascribed the dangerous effects to be the inflammation produced by pulling out a serrated proboscis, and stated his opinion that death would not be produced unless in a diseased and excitable habit of body.—Dr. Traill stated, that its fatal effects had been positively mentioned by Sir R. K. Porter, Mr. Morier and other travellers. During the time that Gen. White was envoy to the Persian Court, the Schah dispatched a messenger after him, who requested him not to pitch his tent on a certain part near the city, on account of the bites of the insects.—Rev. Mr. Hope referred to a similar species in St. Domingo, which attack horses in the ear, and often prove destructive; and the Chairman observed that it was rare to see a drove of oxen in Cuba exempt from the attacks of noxious insects, but which, instead of being prejudicial, were considered beneficial to the animals.

Mr. Halliday laid upon the table some plates of the Argas Persicus, exhibited by Dr. Traill; he stated that there were two genera, the Argas and Ixodes, that produced these poisonous bites.—The President observed, that 'bite' was an improper term for the wounds of these animals. They were produced by the introduction of their long serrated proboscis, and the ill effects frequently attendant on these wounds, he thought, arose from the violent extraction of this serrated rostrum.

Insects not produced by Galvanism.—Mr. Gray offered some remarks on the supposed production of insects, by the experiments of Mr. Crosse, and referred to two experiments made by Mr. Children in a manner perfectly identical with those of the former. The solution of silica was obtained from Mr. Garden in Oxford Street, and in one experiment it was sealed up, whilst in the other it was exposed to the air, but in neither case was there any appearance of insects. The insects had been very indefinitely described by Mr. Crosse, some having six, and others eight legs. It was no proof that they could not have been produced from the water used in the experiment because it was boiled, as that would not be sufficient to destroy the eggs of the insects deposited therein. Rev. Mr. Hope remarked one peculiarity, that no one had given the insects a specific name, and that they merely appeared to belong to the commonest species of Acari.—The Chairman mentioned the circumstance, that the seeds and germs of animals and vegetables are earlier and more quickly developed in a current of electricity, and that in all probability, these favorable circumstances operated upon the eggs of the insects produced in question. It was well known that seeds would retain their vitality for an indefinite period of time, and there was no reason why any limit should be put to the vitality of the eggs of animals.—Mr. Gray stated that prussic acid had lately been used for the purpose of destroying insects at the British Museum, particularly those infesting a mummy. Some of the larvæ of the common Musca having been put into the acid, remained uninjured after two or three days exposure.—Prof. Graham remarked, that other plants and animals might be kept for an indefinite length of time, when the powers of life were either retained or suspended. He also alluded to some curious experiments recently made at Edinburgh, although first by Sir Astley Cooper in London, with respect to the circulation of blood through the brains of particular animals. If the circulation be suspended by pressure for half a minute, the animal becomes torpid, but after giving a few convulsive sobs recovers, whilst if it is suspended for a minute the animal irrecoverably dies.—The Chairman observed that he had often dried to powder the eggs of various insects, which having been put into water were hatched.

On a Method of destroying Insects.—The Rev. Mr. Hope read a letter from Sir Thomas Phillips, on a method of destroying insects which affect books and manuscripts, particularly the *Anobia.* For the purpose of preserving books, he had used paste, in which corrosive sublimate was mixed, which would for some time resist their attacks. He had effected the destruction of *Anobium striatum* in his library, by placing in different parts of it pieces of beech plank, smeared over in the summer with pure fresh paste. It was soon discovered which pieces of the wood were infected, by the saw dust, and these were removed and burnt. So injurious is this species, that he considered that one impregnated female would be sufficient to destroy a whole library. He had also observed two other enemies—a small brown beetle; and one much larger, introduced from Darmstadt or Frankfort-on-the-Maine, which was not very abundant, although very destructive. This latter was about six times the size of the former, of a black color, with white spots or stripes, belonging to the modern family Curculionidæ, and being most partial to books bound in oak boards.

Mr. Curtis suggested the employment of spirits of turpentine, as the effect of corrosive sublimate, and other poisonous substances, lasted only a short time, and soon stained the leather.—The Chairman remarked on the destructive effects produced by Dermestes in his library in Cuba. It was probable that the insects which attacked the paper were different from those which attacked the paste, the former being Acari, and the latter small coleopterous insects. He had found no method of preservation so effectual as to give the books a free current of air, and, for this purpose, he was always accustomed to leave his book cases open, the books being placed about two inches from the wall, so as to allow a free circulation.—Mr. Hope remarked, that the infusion of quassia had been esteemed a preventive; and Mr. Gray stated, that, in Geneva, the water used in the manufacture of paper was that in which quassia had been in-fused.—Mr. Golding Bird referred to the observations of Mr. Gray with respect to the production of insects, as stated by Mr. Crosse in his experiments, which he had repeated on a large scale, but without any result, although he had continued them for some weeks, varying them in every possible form.

Statistics of the Deccan, &c.—The four collectorates of the Deccan, within the province of Bombay, contain a population of 3,285,985 souls, and 48,987 square miles, or about 67 inhabitants to the square mile,—lying on an elevated plateau, formed by the Ghauts, and descending by a succession of steppes to the Coromandel coast. The Poonah collectorate contains 8,281 square miles, 550,313 inhabitants, 1,827 towns and villages, and 114,887 houses, averaging about 4 inhabitants to a house, and 247 to a village, exclusive of the city of Poonah, which contains a population of 181,000. The rivers in the Deccan, during the monsoons, present magnificent streams of water, but, in the dry season, either a broad sandy plain, or a mere thread of water. The roads, with the exception of two great military roads, are untouched by art, and few of the rivers can boast of a bridge. With respect to Geology, there are no organic remains, and probably no country in the world in which the trap rock prevails to so great an extent. In the Deccan there are 200,000 square miles, without the intervention of any other rock whatever. This is succeeded by granite and other rocks of igneous origin, so that from the 25th degree of latitude, to Cape Comorin, including Ceylon, there are 700,000 square miles of igneous rocks and granite. The tides of the atmosphere are one of the principal features connected with the climate of the Deccan. These tides, like those of the ocean, rise and fall twice within the twenty four hours, at stated periods, and with a regularity which can almost be calculated upon. During observations of four years' continuance, made with different instruments, there was no variation in the order of the rise and fall, though there was occasionally some little variation in the degree. The atmospheric tides prevail from the equator to the pole, and are very observable to the 64th degree of latitude,—the maximum being at the equator,—the minimum at the poles. They exist even in our own latitudes, with all their variations. In the Deccan, as throughout the world, the barometer ranges highest in cold weather, and diminishes during the monsoon. The temperature, at half past nine in the morning, is the mean temperature of the year; so that a register kept at that hour, gives the mean temperature of the year. With regard to the quantity of rain, the clouds, containing the water drawn from the ocean by the action of the sun, beat against the Ghauts, and the rain which falls there is fourfold the proportion of that which falls 30 or 40 miles to the eastward. At Poonah, which is only 50 miles east, the annual fall of rain is only 25 inches, whilst in Bombay it is 100. Hail falls only at the very hottest season, with the temperature from 95 to 100. The air is perfectly clear;—suddenly the horizon is overcast, the dust is blown up in dense masses, with occasional violent claps of thunder, and showers of large hailstones. Dews are very copious,—fogs little known. The climate is very salubrious. In his (Col. Sykes's) camp, consisting of 100 persons, not a single death occurred in six years, and there was only one case of sickness which he did not cure without medical aid. In 1828, the deaths were 1.82 per cent., or one in 55 persons, not including cholera, or one in 40 including cholera, so that even in India, where this frightful disease originated, it appears to be much less serious than was supposed. Dr. Lawrence, the medical attendant at Bombay, had charge of 1000 natives for several years, and lost only 0.85 per cent., or less than one per cent. per annum.

Agriculture, though rudely carried on, is very productive; there are forty five cultivated fruits, including six or seven species of the grape, and twenty two wild fruits, including the mangosteen, the date, &c. &c. There are two harvests in the Deccan, one at the hot and wet season, the other at the cold or dry season, and both of distinct kinds of grain or pulse—the harvest at the wet season is principally of rice, which is produced chiefly in the hilly country. The productiveness of some of the grains is perfectly astonishing. Four species were mentioned—one producing 33 stalks, and 61,380 grains from one seed; another, 1,690; a third, 2,985; and a fourth, 1,850. One species of wheat, taken out of a field at random, and now in his possession, contained 25 stalks, and 1,450 grains, the average on tolerable land being 8 stalks to each plant. Besides this, there are corn, barley, peas, and sugar cane. There are 46 articles of garden culture. Edible fruits are numerous, and many wild plants and flowers are used as greens. Col. Sykes stated that the natives are quite as carnivorous as the inhabitants of Europe, so far, at least, as mutton is concerned. The grasses are innumerable, some of them useful for cordage. The inhabitants make no hay, but allow the grass to remain on the ground till dry, when they cut it with sickles. There are few fens, no heaths, and no oaks, elms, or hazels. The Zoology of the Deccan exhibits specimens of all the different varieties. The wild dog is a native of the Ghauts; there are three kinds of monkeys, and two of bats. The domestic poultry of this country is supposed to have originated in India, the two species being identical. Most of the wading and swimming birds are identical with those of Europe. In noticing the fish, Col. Sykes remarked that a certain species of fresh-water fish were found in pieces of water, two thousand feet above the level of the sea, exactly resembling our own salt-water fish. With respect to population, the proportion of male to female births, which in England is 100 to 93—in the Deccan is 100 to 87; and this difference obtains, with very little variation, throughout India, modified by the singular fact exhibited in the excess of grown-up women over men. Sir Stamford Raffles, in his account of the island of Java, states that the proportion of births was 100 males to 82 females, but that the same disproportion did not exist between grown-up people. In the Deccan, the preponderance of male over female children is very strongly marked, but a greater mortality amongst the males at a subsequent period makes the females outnumber the males. The same law, therefore, appears to prevail both within and without the tropics. The average number of deaths throughout the whole collectorate was one in 37, but that was in an exceedingly bad season, when the cholera prevailed. The proportion of marriages is very nearly the same as in England and France, it being one in 125 in Poonah, one in 128 in England, and one in 130 in France. With respect to education—in one province there is only one school to 2452 inhabitants; in another, one to 4639; in a third, one to 3337. The tenures of land are exceedingly numerous, and amongst them is the freehold, which has been acknowledged by the native governments; whilst there are many descendants of those amongst whom the land was originally divided, now in actual possession. Artisans of various kinds do the work of the farmers in their respective branches, and are paid by allotments of land, and a per centage on the produce; thus, the barber shaves for his land; the tailor makes clothes for his land, &c.—which land is cultivated by them to produce food. The revenue derived by the government was 82 per cent. in the aggregate from land, and altogether averaged 8*s.* per annum for each individual. The native manufacture of silk and cotton has been almost suppressed by the machinery of England.

There are few other manufacturing products of any value, and these are not produced in the Company's territories, with one or two slight exceptions. The transit duties on the conveyance of goods are exceedingly onerous, and form a great impediment to commerce.

Statistics of trade between the United Kingdom and the United States of America.—The British colonies which now form part of the United States of America, were, with the exception of Georgia, all founded in the seventeenth century. The date of the first settlement of each individual colony was as follows:—

Virginia	1607	Maryland	1633
New York	1614	Connecticut	1635
Massachusetts	1620	Rhode Island	1636
New Hampshire	1623	North Carolina	1650
New Jersey	1624	South Carolina	1670
Delaware	1627	Pennsylvania	1682
Maine	1630	Georgia	1733

It was not until more than a century had elapsed from the period referred to in the foregoing extract, and when they had secured their independence, that any part of the raw material employed in the cotton manufacture was received from the British plantations in America. A few bags of cotton, which arrived in 1785 and 1786, were apparently of foreign growth, and had been transmitted to America from the Spanish main. Cotton was raised in gardens in the United States before 1786; but that was the first year in which it was cultivated by planters as a crop, and 1787 was the earliest year in which any of the growth of the country was exported.

Before the separation of the British provinces from the mother country, the statements which were given concerning their trade exhibited that of each province separately. Attention was then directed to a table which contained the official value of imports and exports from and to each province, for the years 1701, 1710, 1720, 1730, 1740, 1750, and 1760, and thereafter for each individual year to 1783, when the independence of the United States was fully recognized. For a long period up to that event the operation of the navigation laws had given to this country a monopoly of the trade with its colonies; and Mr. Porter considered it worthy of remark, that so long as the American provinces continued thus connected with England, the increase of the commercial intercourse bore a very inadequate proportion to their increasing population. In

1749 the number of inhabitants in the provinces was stated to be 1,046,000, and the official value of exports and imports was £2,117,845. Assuming that the population between 1749 and and 1774 increased steadily at the rate afterwards exhibited by the census of 1790, the number of inhabitants in 1774 must have been 2,803,625. If the trade had increased in an equal ratio, the imports and exports in 1774 would have amounted to £5,676,523; whereas the actual amount was only £3,964,288, showing a deficiency of 30 per cent.

Another table exhibited the official value of our imports and exports from and to the United States collectively, in each year from 1784 to 1835.

The earliest census for the United States was taken in 1790, when the population was found to be 3,929,328. The official value of our trade with the United States in that year was £4,622,851. In 1800 the population was found to have increased to 5,309,758. At the same rate of increase the trade in that year should have been £6,246,925; but as it actually amounted to £9,243,432, the increase was greater than that of the population by 48 per cent. In 1810, the population was 7,239,903, and the trade £10,427,722. If the proportion of 1790 had been preserved, the amount would have been £8,517,739. The excess, after allowing for the increased population, was therefore 22 per cent.; but if the comparison is made with 1800, it appears that the increased trade is not quite 13 per cent., while the population was augmented at the rate of 36 per cent.; there is therefore a virtual deficiency of 23 per cent., which Mr. Porter considered ought to be ascribed to the operation of the Orders in Council issued in retaliation of the Milan and Berlin Decrees of Napoleon. Pursuing the comparison to 1820, we find that the population was then 9,638,166, showing an increase over 1810 of 33⅓ per cent.; on the other hand, there is a falling off in the official value of the trade between the two countries at the rate of 27 per cent. This circumstance Mr. Porter attributed to causes of a temporary nature, capable of easy explanation. On the renewal of the intercourse between England and America, after the peace in 1815, our merchants and manufacturers, stimulated doubly by the deficiency of British goods in the American market, and their superabundance and consequent low price at home, made such large shipments of manufactures to the United States, that a glut was there produced, and as this occurred simultaneously with a considerable derangement of the currency in the commercial cities of America, English goods were sacrificed at ruinous prices. In the mean time, the commercial distress which had visited our own country was passing away, and an effective demand for our products had arisen from other quarters, as appeared from the fact, that although the real value of British goods exported to the United States, which, on the average of the five preceding years, was near £9,000,000, fell in 1820 to £3,875,286, the general exports from the United Kingdom to foreign countries were greater in 1820 than they had been in the preceding year.

In 1830, the date of the last census, the population of the United States was 12,867,165, and the official value of the trade with this country £16,292,637. The increase, as compared with 1790, was 227 per cent. on the population, and 252 per cent. on the amount of trade. If the comparison is made with the remaining decennary periods, it will be found that the increase in 1830 was as follows:

	Increase per cent. Population.	Trade.
Compared with 1800	142	76
" " 1810	77½	56
" " 1820	33½	115

The increase of population in the United States, between 1820 and 1830, was at the rate of 3½ per cent. per annum. If we assume that the increase has since gone forward at the rate of 3 per cent. in each year, the number of American citizens in 1835 must have been 14,784,589. The official value of their trade with this country in that year was £25,671,602. A comparison of this amount with the value of the trade in the years of the different enumerations, exhibits the following results:—

	Increase per cent. Population.	Trade.
Compared with 1790	276	455
" " 1800	178	177
" " 1810	104	146
" " 1820	53	239
" " 1830	15	57

But Mr. Porter considered that it was not simply with reference to the numerical increase of the citizens of the United States that we should consider this question of the increase of our trade. During the forty seven years that have elapsed since the first census was taken, in 1690, at least 11,000,000 of inhabitants have been added to their number, being equal to an increase of 276 per cent. But during that time we are fully warranted in believing that the wealth of the country has been augmented in a much greater proportion; and it may be fairly presumed that, but for the untoward interference of wars, and of that which is scarcely less inimical to national prosperity than war—commercial jealousy, the dealings between the two countries must have become far more considerable than they are. During the period in question, America has added materially to her means of consuming foreign products by the extent to which she has carried the cultivation of exportable products. In 1791, the whole export of cotton from the United States was under 200,000 lbs.; and it is shown by accompanying tables that the average annual importation of American cotton into this country during the last ten years, has exceeded 225,000,000 lbs., the value of which cannot have been less than £7,500,000 per annum. In 1836 our importation was 289,615,692 lbs., which, at the average price of the year, probably produced more than £10,000,000 sterling.

The intercourse between this country and the United States is important, not only to our merchants and manufacturers, but also to our ship owners, and that in a continually augmenting degree. The tonnage of vessels which entered the ports of the United States from foreign countries, in each year from 1821 to 1836, distinguishing American and British from other shipping, was as follows:—

Years ending 30th September.	American.	British.	Other Foreign Vessels.	Total.	Centesimal proportion of British to American tonnage.
1821	765,098	55,188	26,338	846,624	7.21
1822	787,961	70,669	29,872	888,502	8.97
1823	775,271	89,553	29,915	894,739	11.55
1824	850,033	67,351	35,016	952,400	7.92
1825	880,754	63,036	29,891	973,681	7.15
1826	942,206	69,295	36,359	1,047,860	7.35
1827	918,361	99,114	38,475	1,055,950	10.79
1828	868,381	104,167	46,056	1,018,604	11.99
1829	872,949	86,377	44,366	1,003,692	9.89
1830	967,227	87,231	44,669	1,099,127	9.02
1831	922,952	215,887	66,061	1,204,900	23.39
1832	949,622	288,841	104,197	1,342,660	30.41
1833	1,111,441	383,487	113,218	1,608,146	34.50
1834	1,074,670	453,495	114,557	1,642,722	42.19
1835	1,352,653	529,922	111,388	1,993,963	39.18
1836	1,255,384	547,606	132,607	1,935,597	43.62

The most important part of our trade with America consists in our exports of manufactured goods. The following table exhibits the declared value of those exports in each year from 1805 to 1836, with the exception of 1812 and 1813, the records for which two years were destroyed at the burning of the Custom House in London.* .

Declared value of British and Irish produce, and Manufactures, exported from the United Kingdom to the United States of America, in each year from 1805 to 1811, and from 1814 to 1836.

Years.	Amount.	Years.	Amount.	Years.	Amount.
	£		£		£
1805	11,011,409	1817	6,930,359	1827	7,018,272
1806	12,389,488	1818	9,451,009	1828	5,810,315
1807	11,846,513	1819	4,929,815	1829	4,823,415
1808	5,241,739	1820	3,875,286	1830	6,132,346
1809	7,258.500	1821	6,214,875	1831	9,053,583
1810	10,920,752	1822	6,865,262	1832	5,468,272
1811	1,841,253	1823	5,464,874	1833	7,579,699
1814	8,129	1824	6,090,394	1834	6,844,989
1815	13,255,374	1825	7,018,934	1835	10,568,455
1816	9,556,577	1826	4,659,018	1836	12,425,605

One thing which cannot fail to strike any one on inspecting this table, is the large amount of our exports in the three earliest and two latest years of the series, when compared with those occurring in the intermediate years. The extent of the shipments in 1815, Mr. Porter considered as the result of the renewal of commercial intercourse after the war. The years 1805, 1806, and 1807, 1835, and 1836, followed long periods of friendly intercourse. The serious falling off that occurred in 1808 and 1809, Mr. Porter, as already stated, attributed to the effect of our celebrated Orders in Council, issued in retaliation for Napoleon's Milan and Berlin Decrees. Nearly one third of our foreign export trade in 1805, 1806, and 1807, was carried on with the United States.

The high degree of importance to each country of the trade which it carries on with the other, was shown in Tables appended to the Memoir. The proportions which that trade bears to the entire foreign trade of each country are as follows:

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* This omission is less to be regretted, because of the unfortunate state of hostility into which the two countries were plunged during those years.

Centesimal proportion which the trade between the United Kingdom and the United States of America bore to the whole foreign trade of each country respectively, in each year, from 1821 to 1835.

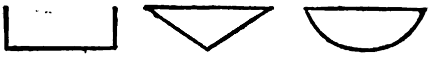
Years.	Centesimal proportion which the trade with England bore to the whole foreign trade of the United States.	Centesimal proportion which the trade with the U. States bore to the whole foreign export trade of England.
1821	35.95	16.95
1822	38.16	18.57
1823	32.70	15.41
1824	31.75	15.86
1825	37.67	18.31
1826	29.60	14.77
1827	35.03	18.87
1828	34.75	15.78
1829	33.75	13.45
1830	33.13	16.02
1831	41.78	24.36
1832	35.99	15.00
1833	35.41	19.36
1834	39.61	16.43
1835	41.76	22.31

The proportion which our export trade with the United States bore to our whole export trade was, in—

1805	28.91	1807	31.80
1806	30.31	1836	23.28

Mr. Porter stated that in the foregoing observations all remarks upon the state of convulsion into which this most important branch of our foreign trade has lately been thrown had been avoided, partly because its occurrence is too recent to allow of a sufficiently calm estimate being made of the cause or causes which led to the catastrophe, but chiefly because it would be difficult, if not impossible, to enter upon that subject without departing from that line of strict statistical research which it is desirable to preserve in the proceedings of this Section of the British Association. In conclusion, he remarked that the shipments of British produce and manufactures, in the year 1836, amounted, according to the value declared by the shippers, to £53,368,571, of which sum America took £12,425,605, or 23.28 per cent. The total shipments in 1835 amounted to £47,372,270, of which America took £10,568,455, or 22.31 per cent., the difference between the two years being, on the total shipments £5,996,301, and on the shipments to America £1,857,150. Without admitting or denying that these figures give evidence of over-trading, he called attention to the circumstances of the two people—namely, that the means of obtaining the comforts of life are enjoyed by a larger proportion of them than is the case with any other people; that the habits and predilections of the citizens of the United States lead them to give a preference to British goods; that ours is the cheapest market in which they can procure many articles necessary to them; and that we are, out of all proportion, their best customers for the raw produce of their soil; and he asked whether, if the trade of the two countries were put upon a proper footing, and conducted upon enlightened principles, that amount of traffic *could* be considered excessive which gives annually to every citizen of the United States articles of British growth and manufacture to the value of sixteen shillings and ninepence three farthings!

On the Mechanism of Waves in reference to Steam Navigation.—Mr. Russell had, at previous meetings of the British Association, given an account of his investigations on the resistance of fluids to the motion of vessels, and ascertained the law of interference of the wave in modifying the nature and amount of that resistance. Since the last meeting of the Association he had extended his observations to a variety of subjects of practical importance, and amongst others to the improvement of the navigation of such rivers as the Thames and the Clyde, in which steam navigation was extensively employed. In these rivers it was found that steam navigation was conducted under very great disadvantages when compared with the open sea. Mr. Russell had discovered that in shallow water one great impediment to high velocities was the generation of, what he termed, the great wave of translation of the displaced fluid,—not undulation of fluid, but translation of one part of the fluid, reaching to the whole depth with equal velocity. When the vessel is propelled, the water heaped on its side generates this great anterior wave of translation, which increases as the velocity increases; the section of displacement of water is increased in the ratio of the sine of inclination. In one instance, where the depth was five feet, the anterior wave was three feet above the level of the water, so that the bow was buried in it, and when the vessel stopped the wave moved at eight miles an hour, and though the vessel drew but twenty inches water, her helm was knocked off. This anterior wave moves with a given velocity proportionate to the depth of the fluid, equal, in fact, to the fall of a heavy body through half the fluid. In some cases, the boat being stopped, Mr. Russell had followed the wave for a mile, and found it advance at the same rate. The object then would be to make the centre of the vessel coincide as much as possible with the centre of the wave, thereby diminishing the anterior wave and diminishing the resistance. This wave is at present generated to so enormous an extent, that in one case the waves extended to a considerable depth for a mile and a quarter, the depth of the river being increased one and a half foot in a channel of five hundred yards. In six or seven feet water the immersion would be three feet more at stem than when the boat was at rest, the progress being doubly impeded by the anterior wave, and by the stern depression. The question then was to what was the wave due? and how was it to be got rid of? In general, the greater the difference between the velocity of the vessel and that of the wave, the more the impediment was diminished. The increase of the velocity of the anterior wave relieves the vessel, and this is obtained, not by widening, but by deepening the channel, while at the same time the velocity of the stern wave is increased, so as to come forward to the centre of the vessel. In one instance a vessel moved at the rate of four miles with twenty two strokes a minute, at six miles with thirty five strokes, and at five and a half miles with from sixty to seventy strokes. The next great impediment to steam navigation consisted in the formation of lateral currents on the side of the vessel, which, having the same direction with the motion of the paddles, had the effect of diminishing the relative difference of the velocity of the paddles and of the fluid, and thus diminished the propelling power of the paddles, the engine being obliged to make an additional number of strokes. The third evil arose from the stern or posterior wave or surge, by which great injury was done to the banks of the river, and to the smaller vessels navigating it. At an increased velocity this wave rises in a cycloid form into a breaking surface. The remedy for these evils was to be found, not in widening the river, as generally supposed, nor in giving gradual or gentle slopes to the sides of the channel, but in deepening the river and rendering its sides as nearly vertical as possible, by which the impediments were diminished to a very great amount. Mr. Russell had made experiments with different forms of channels, as:—



The general result was, that in a rectangular channel the velocity was that due to the fall through half the depth of the channel. Thus the velocity of a wave of one foot was three miles an hour, of one of four feet eight miles, of one of fifteen feet fifteen miles. In all cases the rectangular channel was found to be the preferable one. Such a channel would generally be the most expensive, but sometimes, where, as on the Thames, the land adjoining was of high value, and gentle slopes to the banks were therefore not attainable, the rectangular would be the cheaper form.

The next wave generated was what Mr. Russell termed the wave "of unequal displacement," arising solely, it was found, from the form of the vessel. This wave was seen diverging on both sides of the vessel, from the bow towards the stern, arranged in two straight lines extending to a great distance behind it. This wave might be greatly diminished, and sometimes almost entirely removed, by giving the lines of displacement a slight concavity towards the stern, the vessel being sharpened out. When the vessel does not raise the water in giving uniform progression, but is so bluff that certain points displace more than others, an anterior wave is formed of excessive displacement, the injury done by which is only inferior to that of the stern surge.

Mr. Fairburn, of Manchester, stated, in reply to a question put by Dr. Lardner, that the results of his experiments corresponded with those obtained by Mr. Russell, and mentioned one instance where, at a velocity of seven miles an hour, the channel being five feet deep, the stern was dragging on the ground.—Mr. Herapath inquired what posterior form of vessel Mr. Russell had found the best. Mr. Russell stated that on this point the result of his experiments indicated a form very different from that approved of by naval officers in general. They preferred a form bluff in front, and tapering towards the stern. Mr. Russell's experiments went to show that this should just be reversed, and he had made sixteen of them at different velocities, from three to fifteen miles an hour. In the navigation of the Clyde, the progress of the formation of vessels had been in accordance with this opinion. At first they were built very bluff, with their maximum breadth at a distance from the stern of one-third of the whole length; thus a wave of excessive displacement was generated, going off at right angles, and making a break more than was necessary to allow the stern to pass through. Now the vessels were built with full sterns and narrow stems, with their maximum breadth at midships. For working well, however, a very deep keel was, he knew, necessary to give the helm full effect. In answer to the question whether these experiments might be made with model vessels on a small scale, Mr. Russell said that experiments with models were generally very fallacious and complicated, and that his had been made with vessels from seventy five to one hundred feet long. When asked whether they were made with or against tide, he replied that the existence of a previous current modified the velocity of the wave, which was to be measured by the velocity of the water, not by the land.—Mr. Wenfall observed that Mr. Russell's statements were corroborated by an observation of his own, that in an instance where the tide rose thirty six feet, the effect of the lateral waves had been to form a rectangular excavation to four or five feet.

On the Corroding of Iron by Salt Water.—Mr. Hartley read a paper, 'on the corroding of iron by salt water.' The object of the paper was to show that brass protects both bar and cast iron in a very perfect manner. The brass did not appear to have undergone any action, which, as stated by the President, is rather opposed to received notions of electro-chemical action.

On some singular Modifications of the Ordinary Action of Nitric Acid on certain Metals.—Dr. Andrews next read a paper, 'on some singular modifications of the ordinary action of nitric acid on certain metals.' Bismuth in nitric acid of specific gravity 1.4, was rapidly acted upon, but this action immediately ceased when the bar was touched by platinum. On removing the platinum from the liquor, the bismuth will sometimes begin again to dissolve; at other times, its surface will become covered with a black crust, which is soon removed by the acid; but the metal, though now exhibiting a beautifully polished surface, is no longer acted upon by the acid, or, at least, is dissolved only with extreme slowness. Thus, a slip of metal, which, in its ordinary state will require only a few seconds to complete its solution, will, when thus slightly modified, resist, for many hours, the action of the same acid.

Copper and tin present similar phenomena, but zinc, when treated in the same way, has its oxidation and solution not arrested, but merely retarded. Arsenic was found to present a singular anomaly when heated in nitric acid, so as to give rise to effervescence: the contact of the platinum in the usual way did not produce any effect, whereas, when an acidulous solution of silver is used, platinum exercised its usual influence.

In the case of six metals, platinum checks the action of nitric acid, and three of them appear to be brought into a permanently peculiar state, opposed to chemical action. Platinum always separates any film of oxide as its initial function, but after its separation, it exercises a polarizing action, for example, it brings the other metal into a peculiar state, which enables it to resist chemical action.

On the conclusion of this paper, the President drew the attention of the Section to the analogy between the facts detailed by Dr. Andrews, and the preservation of iron by brass, as instanced in the communication of Mr. Hartley. In both cases, according to the known laws of electro-chemical action, effects, the very opposite of what are observed, should present themselves. The bismuth, copper, &c. should oxidize quickest when in contact with the platinum; and if, as would seem demonstrated by Mr. Hartley, brass protects wrought and cast iron, the brass itself should be acted upon with increased rapidity. The solution of these anomalies, he conceived quite within the range of science in its present state, and he urged upon the members of the Section the necessity of studying the phenomena in question, as their explication would constitute a very valuable addition to the existing state of our electrical knowledge.

Gravel, bowlders, &c.—Mr. Sedgwick had seen gravel on mountains two thousand feet high. Erratic blocks, he considered, could not be of fluviatile, but of marine origin, and organic remains of large animals were not likely to be abundant in gravel carried by currents of the sea, from the destruction caused by their violent action. Animal remains had been found in the clay gravel of the east of England; but this gravel he conceived as differing from that in other parts of the country.—Sir Philip Egerton said, that Mr. Strickland's flintless gravel, occurring to the N. W. of the Avon, could be only a partial formation, as he had observed, that in Cheshire the gravel always contained flint. At Cocknell he had obtained two grinders of an elephant, and many *marine* shells, and many like shells in other places, all of existing species, and occurring often with pieces of rolled coal.—Mr. Phillips stated, that one of the questions proposed by the Association, was the determination of the phenomena of the English gravel formations, but to the present time sufficient evidence had not been collected. He alluded to Mr.

Murchison's opinions, that a strait formerly divided England from Wales: into this strait gravel might be drifted from both sides; and Mr. Murchison had discovered, in Wales, local covered by erratic gravel. He himself had discovered in a valley of the Yorkshire Wolds at an elevation of six hundred feet, gravel drifted from Cumberland, and containing bones of the elephant.—Mr. Sedgwick had traced the gravel of the central parts of England to its northern sources; and he instanced a singular phenomenon of a mountain, near Buttermere, which appeared to be water-worn by a stream passing over it. The recent elevation of Siluria, he conceived, was proved by the morasses and lakes in its lines of valleys, which valleys, although shaped under the ocean, had been evidently modified by existing waters. He concluded by asserting, that all examination of nature, by means of accurately ascertained facts, must agree with moral or scriptural interpretation; and that we need have no fear as to the one clashing with the other, as truth cannot oppose truth, but must, in all cases, be coincident.

Geology of the Desert between Suez and Cairo.—In this desert travellers have always suffered great inconvenience from the want of water, and this was likely to prove a serious obstacle to the proposed communication by this route to India. In order to overcome the inconvenience, Mr. Briggs, the British consul, employed a Swiss engineer to bore for water. Mr. Gensberg, the engineer, caused the first boring to be made in the Valley of Kejche, but being unsuccessful, he transferred his operations to the Valley of Candelli, where water was found in clay underlying a calcareous rock. Considerable ingenuity was shown in the excavation. Besides the usual boring downwards, lateral openings were made to increase the supply of water: borings were made in other situations, and very singular results obtained. A great variety of strata were penetrated, and this variety existed even within a limited distance of superficial extent: thus, in one place marine sand was found; and a little way off, terrestrial or desert sand: gravel occurred only in one spot. But the most singular geological phenomenon was the existence of granite over clay, in which good water was obtained. The marquis mentioned that a notice of the intention of the British consul to bore for water, appeared in the first volume of the Journal of the Geographical Society, but that the communication now laid before the Section, was the first notification of the results obtained.

The Sclerotic Bones of the Eyes of different Birds and Reptiles.—Mr. Allis read a paper 'on the sclerotic bones of the eyes of different birds and reptiles.' He stated, that he believed the subject of his paper had not received much attention from comparative anatomists. With regard to their number, Cuvier had stated them to be twenty, but he had never found more than seventeen, and sometimes even only one. He then quoted the observations that had been made on this subject by Blumenbach, Cuvier, Carus, Yarrell and Buckland, and proceeded to state, that "the shape of the individual bones is so various, that it cannot be given in any general terms; the external edge of the bones is, in most instances, beautifully serrated, but the serration is not visible in the bony ring: this serration being generally destroyed by the process of boiling that is necessary to their preservation. The rings generally overlap each other, there being a depression on the under side of one bone, and a precisely corresponding one on the upper side of its fellow; so that when overlapping each other they present nearly an even surface, having one bone with both depressions on its inner surface, and forming an interior key to the arch; another, having two depressions externally, and forming an exterior key. They form a defense and protection to the eye, and those birds which are pugnacious, or have a peculiarly rapid flight, or vary their attitude in flying, &c., have the sclerotic rings of larger size and more convex form, and are of greater strength; the same remark holds good with respect to water-birds. Another use of these bones, is, altering the convexity of the cornea, as mentioned by Dr. Buckland." He then exhibited a great number of specimens of these bones, and observed, that in the eagles and vultures they were strong and large, and varied in number from fourteen to sixteen; in owls, soft and porous, and not hard, as Cuvier had stated; in the gallinidæ the the number varied from thirteen to seventeen; in the columbidæ they were small and feeble; in the ostrich tribe they were large; in the grallæ small and feeble; in the scansores the same, and twelve or thirteen in number; in the swimmers they were weak and small, and from twelve to sixteen in number; in divers, strong and large, and twelve to fifteen in number; in the passerinæ they varied considerably, but were generally weak; in reptiles they varied considerably in number, shape and size.

Chemical Composition of Vegetable Membrane and Fibre.—A paper 'on the chemical composition of vegetable membrane and fibre,' by the Rev. J. B. Reade, was read by the secretary. The author commenced by observing, that Professor Henslow, in his late work on Botany, had stated, that great difficulties existed in the way of obtaining an accurate analysis of the chemical composition of vegetable membrane and fibre. Having observed the accuracy with which his friend, Mr. Rigg, of Walworth, analyzed vegetable products, he recommended him to commence a series of experiments on this subject, and obtained the following results:—

Spiral vessels from the Hyacinth yielded—

Carbon - - - - - -	41.8
Hydrogen - - - - - -	1.1
Nitrogen - - - - - -	4.3
Water - - - - - -	51.8
Residuary matter - - - - -	1.0
	100.0

Cellular tissue:—

Carbon - - - - - -	39.2
Oxygen - - - - - -	7.4
Nitrogen - - - - - -	3.9
Water - - - - - -	48.5
Residue - - - - - -	1.0
	100.0

An analysis of different parts of the flower-stalk of the hyacinth gave the following results:—

	C.	H.	O.	N.	W.	Res.
Epidermis and stomates -	41.7	—	2.0	4.0	50.8	1.5
Cellular tissue beneath epidermis	41.8	—	2.1	4.1	50.5	1.5
Woody fibre under bark -	39.2	0.5	—	5.7	55.6	1.0
Spiral vessels - - -	35.8	1.7	—	3.9	58.1	0.5

In these experiments, the existence of nitrogen to so great an extent was pointed out as remarkable.

Vegetable Physiology.—Mr. Nevan detailed some experiments 'on vegetable physiology.' The experiments were performed on elms, forty years of age in February, 1836.

1. The stem of the tree was denuded, in a circle, of its cortical integument alone, leaving the alburnum beneath uninjured. On the May following the denuded part was filled up by the exudation of bark and wood from the upper surface of the wound, and the tree had not suffered in growth.

2. The bark and *cambium* were removed in the same manner. In August, 1837, this tree sickened, and there was no formation of wood or bark in the wounded part. Two developments, however, took place, one above the other, from below; the former having the appearance of roots, the latter were branches with leaves.

3. The bark and two layers of alburnum were cut away. The tree was at the time unhealthy; it, however, put forth its leaves on that and the ensuing spring, but shortly after died. No sap was observed above or below the wounded part. Roots were developed from the upper, and branches from the lower part of the section.

4. The bark and six layers of alburnum were taken off. The tree became much less vigorous, but did not die, and otherwise presented the same appearance as the last.

5. The bark and twelve layers of alburnum were stripped. The consequences were again similar to the last two; the alburnum above and below the cut being dry, but an accidental cut that penetrated into the heart-wood exuded sap.

6. This was a repetition of the experiment of Palisot de Beauvais, by cutting away a circular ring of bark around a single branch. The branch continued to grow, and roots sprouted from the under surface of the isolated bark and branch.

7. In this the whole of the wood of the tree was cut away, except four pillars, composed of bark and sap-wood. In this case, the sap first appeared from above, descending by the pith, and then from the heart-wood, the alburnum being dry. In this case the sap must have passed up the alburnum, and horizontally through to the heart-wood.

Mr. Nevan inferred from these experiments—1. That the life of the tree does not depend on the liber or cambium. 2. A descent of sap takes place before the development of leaves. 3. That new matter arises from below; which had not previously been allowed. He thought there were two distinct principles in the tree,—one, the ascending, or leaf principle; the other, the descending, or root principle. Mr. Nevan had also performed some experiments on the conversion of roots into branches, and came to the conclusion, that buds or branches might be developed from any part of the root above its extreme end, from which point it was impossible for buds to be developed.

Professor Lindley remarked that these experiments confirmed entirely the theory of the structure of wood adopted by Du Petit

Thouars. He did not think that the existence of any new principle could be inferred from the experiments. In the seventh experiment the horizontal circulation of the sap was proved, and confirmed the accuracy of Hall's experiment of cutting a tree nearly through on alternate sides, when the sap still ascended.

Suspended Animation.—Sir James Murray had seen two cases of suspended animation from blows on the stomach; one recovered, and the other died. The remedy he should recommend, would be to throw a bucket of cold water over the body—gasping would ensue, and respiration follow.

Iron.—Mr. Fairburn then read a Report on the comparative strength and other properties of cast iron, manufactured by the hot and cold blast.

At a previous meeting of the Association, Mr. Hodgkinson read a Report on the comparative strength and other properties of iron manufactured by the hot and cold blast.—In the prosecution of inquiries since made, it was conceived desirable to subject the metals operated upon to more than one species of strain; to vary their forms, and, by a series of changes, to elicit their peculiar, as well as comparative properties. 1st, they have been drawn asunder by direct tension; 2dly, they have been crushed by direct compression both in short and long specimens; and, 3dly, they have been subjected to fracture by transverse strain, under various forms of section, and at various temperatures. Ten bars of hot and cold blast iron were also loaded with different weights, from 112 lbs. to near the breaking point, and left for many months to sustain the load, and to determine the length of time necessary to effect the fracture. The bars thus loaded, are still (with one exception) bearing the weight, having been suspended upwards of six months, and, from what we can at present perceive, there is every chance of a long and protracted experiment. In making the experiment on transverse strain, a number of models of different sizes and forms were prepared, and the irons, both hot and cold blast, were run into the form of these models; but as there is usually a slight deviation in the size of the castings from that of the model, the dimensions of the bars were accurately measured at the place of fracture, and the results reduced, by calculation, to what they would have been if they had been cast the exact size of the model, assuming the strength of rectangular beams to be as the breadth and square of the depth, and the ultimate deflection to be inversely as the depth, the length being constant. In comparing two irons, the greatest care was taken to subject them as nearly as possible to the same treatment.

A series of experiments was also made to determine the strength of hot and cold blast iron at various temperatures, from 32° (the freezing point) to the boiling point; for this purpose, a cast-iron trough was employed, in which the bars to be broken were placed, and covered with snow or water, (which was kept at the proper temperature by a jet of steam,) as the case required; the weights were then gradually laid on until fracture took place.

The strength of bars made red hot was also tried, and, contrary to expectation, they retained their tenacity and power to resist the load to a considerable extent: the reduction of strength in a bar one inch square, in a range of temperature from 32° to that of redness, was rather more than one-sixth, the deflection being upwards of 1½ inch in a bar 2 feet 3 inches long.

RESULTS.

Carron Iron, No. 2. (Scotch.)

Mean ratio of transverse strength, assuming the cold blast iron at - - - - - - -	1,000 : 9,799
Mean ratio of power to resist impact - -	1,000 : 1,038.9

Whence, in the transverse strength of Carron iron, No. 2, using a variety of forms of section, the strength of the cold blast is to that of the hot blast, as 100 to 98, nearly.

Devon Iron, No. 3.

Mean ratio of strength in sections of various forms (thirteen experiments) - - - -	1000 : 1409
Power to sustain impact - - - -	1000 : 2742

This is an exceedingly hard iron, with a singular appearance, the centre or more granulated parts of the fracture being surrounded with a circle having the appearance of hardened steel.

Buffery, No. 1, Staffordshire Iron, cold and hot blast.

Mean ratio of breaking weight - - -	1000 : 925
Mean ratio of power to resist impact - -	1000 : 965

In the buffery iron, the hot blast manufacture is weaker, whether we view it in its transverse strength, or its power to resist impact.

Coed Talon, No. 2, North Welsh Iron.

Mean ratio of strength in a number of experiments	1000 : 1014
Mean ratio of power to resist impact - -	1000 : 1219

Modulus of elasticity in lbs. for a bar of one inch square.

$$\text{Cold blast}\left\{\begin{matrix}14{,}680{,}000\\13{,}947{,}000\end{matrix}\right\}14{,}313{,}500\text{ lbs.}$$

$$\text{Hot blast}\left\{\begin{matrix}15{,}810{,}000\\12{,}835{,}000\end{matrix}\right\}14{,}322{,}500\text{ lbs.}$$

Elslear Cold Blast, No. 1, against Melton Hot Blast, No. 1, (Yorkshire Iron.)

Mean ratio of strength - - - - - - 1000 : 809
Mean ratio of power to resist impact - - - 1000 : 858

The modulus of elasticity in all the irons are computed; but only given in a few cases in the results.

Relative strength of hot and cold blast iron to resist a transverse strain at different degrees of temperature.

Cold blast 949.6 at 32°. Hot ditto 919.7, Mean.
Ratio of strength, 1,000 : 977.6.
Power to resist impact, 1,000 : 1,039.
Cold blast 748.1 at 191°. Hot ditto 823.6.

In these experiments, it appeared, that the cold blast lost in strength from 32° up to a blood red, perceptible in the dark as 949.6 to 723.1; whereas, in the hot blast the strength is not so much impaired, being as 917.7 at the freezing point, and 829.7 when perceptibly red in the dark.

In all former experiments on the transverse strain of cast iron, it has been assumed, that the elasticity remained perfect up to one third the breaking weight. In pursuing these experiments, discrepancies were noticed, and results widely different to those generally received were observed. It was found that one seventh, and, in some cases one eighth the breaking weight was sufficient to produce a permanent set. These facts induced an extended series of experiments, principally to determine what load was necessary to effect a permanent set; and, if such weight continued for an indefinite time, would break the bar. It became a question of great importance to know, if a weight, having once impaired the elasticity, would or would not, if continued, increase the deflection. The inquiry, therefore, was—To what extent can cast iron be loaded without endangering its security? To solve this question ten bars of hot and cold blast, differently loaded, were placed upon a frame, to ascertain the amount of deflection at stated periods, and to determine what was necessary to break the bars with their respective loads.

In the cold blast, with a load of 280 lbs., the deflec- Inches.
tion increased in 103 days from - - 1,025 to 1,033

Hot blast, ditto, from - - - - 1,173 to 1,197
Cold blast, with a load of 336 lbs., increased in 105 days, from - - - - - - - 1,344 to 1,366
Hot, ditto, from - - - - - - 1,573 to 1,627
Cold, with a load of 392 lbs., increased the deflection in 108 days, from - - - - - - 1,786 to 1,843
Hot, ditto, from - - - - - - 1,891 to 1,966

Cold blast, with a load of 448 lbs., continued to increase in deflection, and ultimately broke, after sustaining the weight 35 days. All the bars from the hot blast broke in the act of loading them with the above weight, 448 lbs.

Mr. Fairburn stated, that all the irons were made of the same materials, and under the same circumstances. The irons were of fifty sorts.

Mr. Cottam inquired as to the elastic forces. Dr. Young and Mr. Tredgold had found that the strength of the material would fail if loaded beyond its elastic force; he wished to know whether the loads had been more or less than 850 lbs. to the foot. Mr. Fairburn stated that some of the loads were more, some less, and that a weight of 280 lbs. produced a permanent set of an inch square bar. The President remarked, that the calculation as to elastic forces was scarcely to be confided in. Mr. Fairburn, in answer to another question, stated, that the hot blast iron was the more flexible and better capable of bearing impact; but that all the results of impact had been taken from calculations founded on cold blast iron. Mr. Fairburn stated, that the crystalline appearance was finer in hot than in cold blast. There were no experiments made on the loss by remelting, and none on wrought iron,—all on cast iron. In reply to Mr. Cottam, he mentioned, that all the Scotch irons had no cinder; the composition of the others they did not know. Great difficulty had been experienced on this point, because the different manufacturers were unwilling to give information.—Mr. Guest professed on his part the fullest readiness.—Some conversation took place with regard to the peculiarity of appearance in the broken bars. The President remarked, that when a rectangular bar of any substance is exposed either to fracture, or even to temporary deflection, a similar appearance was found: this was known from the experiments on glass by polarized light. Mr. Fairburn in assent said the crystals were always more compact in the edge than in the centre. Mr. Webster inquired whether the elastic weight was always less than one third of the breaking weight. Mr. Fairburn said, always—and afterwards replied to a question from Mr. Guest, that the Scotch hot blast iron showed a greater comparative strength as compared with cold blast, but that they had made no experiments on South Welsh iron. There was a perceptible permanent set from 280 lbs., the experiments being of from five to ten minutes in duration, and it being possible to judge the deflection to the one thousandth part of an inch.—Mr. Webster said it had been found that the first set was owing to the breaking of the first crust, and that beyond the first permanent set up to the elastic limit, the deflexion increases exactly as the weight. Some further conversation ensued, in which Mr. Smith and others took part, when Mr. Guest suggested the propriety of further continuing these researches, to which the President agreed, and suggested a recommendation to this effect from the committee of the section to the general committee. Thanks were then voted to Mr. Fairburn for the zeal and skill with which he had prosecuted these researches for the Association.

Rail Roads and Canals in the United States.—Prof. Henry, of New Jersey College, Princeton, U. S. then addressed the section, and said, he had been requested to present to the Association a map of the United States, in which were marked the railways and canals completed and in progress. They had been fully described in some French works lately published, and in the American Almanac. After enumerating several geographical facts well known to our readers, as to the three natural divisions of America, the Atlantic slope, the middle basin of the Mississippi, and the Pacific slope, &c. he mentioned that there were now one thousand five hundred miles of railway in operation in the United States, and two thousand miles of canals; and that three thousand miles of railway were in progress, which had been in a great degree interrupted, owing to the late commercial convulsions.—In answer to a question put by Mr. De Butts, he stated, that, on the Hudson, there being very little current, one hundred and fifty miles were frequently accomplished by the steamboats in nine hours.—Dr. Lardner much doubted, whether a speed of fifteen miles an hour could be generally attainable.—Mr. Webster stated, that Mr. Blunt, an American engineer, had, in a pamphlet which he quoted, declared, that the American boats had accomplished seventy four miles in five hours, and that the distance from New York to Albany, one hundred and fifty miles, was performed in ten hours by boats built principally with a view to speed.

(To be continued in the next No.)

Art. XIII.—*Remarks on the occurrence of the Aurora Borealis in Summer; with an abstract of Huxham's Auroral Register from* 1728 *to* 1748; by Edward C. Herrick.

At the recent meeting at Liverpool of the British Association for the Advancement of Science, Prof. Christie read a paper, in which he stated his belief that "the occurrence of an Aurora Borealis in England in the middle of summer, is a phænomenon hitherto unrecorded."* This belief is erroneous; and as the opinion is very generally entertained, that the Aurora Borealis is peculiarly a winter phenomenon, it may be worth while to show from published records that it pertains to midsummer no less than to midwinter.

Nearly a century since, John Huxham, one of the most learned physicians of his time, published at London a Treatise on Epidemical Diseases.† Supposing that much information concerning the causes of epidemics might be derived from observations of the weather, he devoted uncommon attention to meteorological studies. In his work, besides the ordinary phenomena of the weather, which he records with much apparent care, he furnishes a register of the Aurora Borealis for the space of twenty years. It cannot be supposed that his record is perfect; for without extraordinary care and good fortune, occasional omissions are unavoidable; yet it is probably a faithful and tolerably complete account of the Aurora Borealis, as seen at Plymouth in England during the time above stated.

A mere quotation from this work, of the great displays of the Aurora Borealis observed in summer, would be sufficient for my present purpose; but as a record of this kind furnishes valuable data for determining whether, as is commonly supposed, the phenomenon returns at certain epochs with unusual frequency and brilliancy, I will here note every case which the author has recorded.

In most of the instances which he has registered, the general character of the event is indicated by a single word; in other cases the date only is mentioned. In some of the more important cases, he adds a short and comprehensive description. The dates are given in "the Julian or old style."

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* See an account of Prof. Christie's Memoir, in the London Athenæum of Sept. 30, 1837, (No. 518,) p. 718.

† Observationes de Aëre et Morbis Epidemicis, ab anno 1728 ad finem anni 1737, Plymuthi factæ, etc. Auctore Joanne Huxham, M.D. R.S.S.—edit. secunda, Londini, 1752. 8vo.—Vol. alterum, ab anni nimirum initio 1738, ad exitum usque 1748. Londini, 1752. 8vo.—The first edition of the first volume was published about 1739. I quote from the second edition.

1728.	Feb. 26.	Slight.
	Mch. 22.	
	23.	Slight.
	July 2.	Very great: corona.[*]
	4.	Slight.
	17.	Slight.
	22.	Unusual: slight.
	Aug. 18.	
	20 ?	
	Oct. 1.	
	14.	Slight.
	15.	
	22.	
	Nov. 22.	Slight.
1729.	Jan. 6.	Very great.
	14.	Great.
	Apl. 11.	
	21.	Slight.
	May 6.	Slight.
	Sept. 12.	
	Oct. 14.	
	Nov. 5.	Great.
1730.	Feb. 23.	Very great.
	Mch. 9.	Slight.
	Apl. 1.	Slight.
	Aug. 28.	Great.
	Sept. 24.	Slight.
	26.	Bright.
	27.	
1731.	Feb. 19.	Slight.
	Apl. 26.	Very great.
	Aug. 16.	Slight.
	Sept. 13.	Slight.
	27.	Very great.
	Dec. 19.	Slight.
1732.	Jan. 18.	Slight.
	Feb. 7.	Slight.
1733.	Feb. 2.	Slight.
	Mch. 21.	Slight.
	June 27.	Very great.
	July 10.	Great.
1733.	Sept. 8.	Great.
	29.	Slight.
	Oct. 27.	Great.
	Nov. 27.	Great.
	29.	
1734.	May 14.	Slight.
	15.	Slight.
	Sept. 9.	Slight.
1735.	Aug. 20.	Great.
	Oct. 3.	Slight.
1736.	Feb. 6.	Great: corona.
	7.	Slight.
	19.	Slight.
	Aug. 25.	Narrow zone fr. E. to W.
	29.	
	Sept. 26.	Slight.
	27.	Slight.
	Oct. 27.	
	Nov. 7.	Slight.
	8.	Greater than 7th.
	13.	Great and variegated.
1737.	Mch. 7.	Slight.
	18.	
	Aug. 9.	
	10.	Very gr't: corona: fiery.
	11.	do. do. do.
	12.	Slight.
	Nov. 1.	
	7.	
	Dec. 1.	Great. Uncertain.
1738.	Jan. 14.	Great.
	Apl. 5.	Slight.
	Oct. 21.	
	24.	
	25.	
	27.	
1739.	Feb. 23.	Great.
	Mch. 1.	Great.
	15.	Great: corona: fiery.
	30.	Great: corona.
	Apl. 20.	Great: fiery.

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[*] The description of this case would apply very well to the display of July 1, 1837, as seen here. "Permagnum observavi Lumen Boreale, cujus Radii lucidi at non colorati, vibrantes, terminari videbantur in coruscante quasi Umbella, paulo ultra Zenith." Vol. i. p. 12.

1739.	Sept. 12.	
	13.	
1740.	Mch. 12.	Great.
	13.	Slight.
	14.	
	May 27.	
1741.	Mch. 5.	
	9.	Slight.
	21.	
	June 29.*	
	July 12.	Very great.
	Sept. 21.	Great.
	27.	
1742.	Feb. 20.	
	Mch. 5.	Slight.
	6.	Narrow zone from N. E. [to S. W.
	15.	Very great.
	16.	
	24.	
1743.	Jan. 12.	Great.
1743.	Mch. 8.	Very great.
	Apl. 1.	Slight.
	June 28.	Slight.
1744.	Mch. 22.	Brilliant.
	Dec. 14.	
	24.	
1745.	Feb. 9.	Great,
		and a slight one in Feb. without date.
1746.	Feb. 9.	
	27.	
	Mch. 14.	
	Oct. 7.	
	Dec. 28.	
1747.	Jan. 2.	Slight.
	Mch. 22.	
	Nov. 21.	Great.
	Dec. 6.	Very great: fiery.
1748.	Jan. 22.	Slight.
	Aug. 28.	Very great: fiery.
	Dec. 4.	Great.

From the above register, it appears that some of the most brilliant displays of the Aurora Borealis witnessed during the period of record, occurred in June, July and August.

Dr. Henry Gibbons, in a valuable essay on the Aurora Borealis, contained in "The Advocate of Science and Annals of Nat. Hist." 8vo. Philad. 1834, Vol. i. p. 21–25, gives a tabular view of all the Auroræ witnessed by him at Wilmington, Delaware, from Aug. 28, 1827, to the end of December, 1833, together with the meteorological circumstances of each occurrence. This record plainly contradicts the prevailing opinion stated in the former part of this paper. The following are the dates of each instance: 1827. Aug. 28; Sept. 8, 9, 25; Nov. 9, 18.—1828. Jan. 18; Sept. 26, 27.—1829. Jan. 28; March 18; Dec. 19.—1830. May 6, 14, 15; June 10, 11; July 14; Aug. 15, 20; Sept. 12, 15, 16, 17; Oct. 9; Dec. 11, 12.—1831. Jan. 6, 7; Feb. 6; March 8; April 20; May 8; June 10; July 4, 5, 10, 31; Oct. 29.—1832. Jan. 22; March 27; Aug. 22, 23; Sept. 30; Nov. 14.—1833. Jan. 2; March 21; May 17; June 17; July 10; Oct. 13; Dec. 15.

The Aurora has been abundant during the recent summer. It was observed here three times in June, seven in July, and six in August. There were fourteen evenings in June, seven in July, and ten in August, in which the sky was overcast, so that no Aurora could have been seen.

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* This case is uncertain. "Arcus nempe igneus lucidus valde ab horizonte prope S. E. ad gradus saltem 90 projectus."

A display of the Aurora Borealis is often a very extensive phenomenon. That of February 18, 1837, which was seen in many parts of Europe, was also noticed here.* Prof. Christie, in his memoir above cited, mentions its occurrence in England this year, May 19, June 24, July 1, 2, 7, and August 25. At this place, on the night of May 19, the sky was entirely overcast, and rain was falling: observation on the Aurora was of course impossible. On the 24th of June, there was an unusual display here and in Vermont. On the 1st of July, the exhibition was very grand, and nearly equal to any ever witnessed in this region.† A slight appearance of it was seen on the 2d. The evening of the 7th was mostly overcast, and the moon was shining. No Aurora was detected, and none, unless uncommonly brilliant, could have been seen. On the 25th of August there was here a moderate display; at Castleton, (Vermont) a corona was formed, and the whole exhibition was one of great brilliancy and beauty.

It is greatly to be desired that careful contemporaneous observations on the Aurora Borealis should be made by persons stationed at many different and distant places. Within the last two hundred years, a vast multitude of isolated accounts have been recorded, most of which are of comparatively little value to science. A tenth part of the labor which they have cost, had it been spent in well concerted contemporaneous observations in different parts of the world, would long ere this have contributed important data for a satisfactory theory. The most probable opinion is, that the Aurora is in some way a result of magneto-electric action, but the laws which govern its capricious appearances have thus far eluded all investigation.

No facts have to my knowledge hitherto been published which throw any light on the question, whether during an appearance of the Aurora in the United States, attended by a disturbance of the needle, a correspondent magnetic disturbance and auroral appearance can be detected at about the same distance from the corresponding magnetic pole in New Holland. Is it too much to hope that some of the many American ships which traverse the Indian ocean, where opportunities for making the necessary observations must often occur, will hereafter bring home the desired information?

New Haven, Conn. Nov. 11, 1837.

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* See this Journal, vol. xxxii. p. 396.

† See p. 144 of this volume.

Art. XIV.—*Some account of two visits to the Mountains in Essex County, New York, in the years* 1836 *and* 1837; *with a Sketch of the Northern Sources of the Hudson;* by W. C. Redfield.

Notwithstanding the increase of population, and the rapid extension of our settlements since the peace of 1783, there is still found, in the northern part of the state of New York, an uninhabited region of considerable extent, which presents all the rugged characters and picturesque features of a primeval wilderness. This region constitutes the most elevated portion of the great triangular district which is situated between the line of the St. Lawrence, the Mohawk, and Lake Champlain. That portion of it which claims our notice in the following sketches, lies mainly within the county of Essex, and the contiguous parts of Franklin, and comprises the head waters of the principal rivers in the northern division of the state.

In the summer of 1836, the writer had occasion to visit the new settlement at McIntyre, in Essex County, in company with the proprietors of that settlement, and other gentlemen who had been invited to join the expedition. Our party consisted of the Hon. Archibald McIntyre of Albany, the late Judge McMartin of Broadalbin, Montgomery county, and David Henderson, Esq. of Jersey City, proprietors, together with David C. Colden, Esq. of Jersey City, and Mr. James Hall, assistant state geologist for the northern district.

First Journey to Essex.

We left Saratoga on the 10th of August, and after halting a day at Lake George, reached Ticonderoga on the 12th; where at 1 P. M. we embarked on board one of the Lake Champlain steamboats, and were landed soon after 3 P. M., at Port Henry, two miles N. W. from the old fortress of Crown Point. The remainder of the day, and part of the 14th, were spent in exploring the vicinity, and examining the interesting sections which are here exhibited of the junction of the primary rocks with the transition series, near the western borders of the lake, and we noticed with peculiar interest the effect which appears to have been produced by the former upon the transition limestone at the line of contact; the latter being here converted into white masses, remarkably crystaline in their structure, and interspersed with scales of plumbago.

On the evening of the 13th we were entertained with a brilliant exhibition of the Aurora Borealis, which, between 7 and 8 P. M., shot upward in rapid and luminous coruscations from the northern half of the horizon, the whole converging to a point apparently fifteen degrees south of the zenith. This appearance was succeeded by luminous vertical columns or pencils of the color, alternately, of a pale red and a peculiar blue, which were exhibited in great beauty.

On the 13th we left Port Henry on horseback, and, after a ride of six miles, left the cultivated country on the borders of the lake and entered the forest. The road on which we traveled is much used for the transportation of sawed pine lumber from the interior, there being in the large township of Moriah, as we were informed, more than sixty saw-mills. Four hours of rough traveling brought us to Weatherhead's, at West Moriah, upon the Schroon river, or East Branch of the Hudson, thirteen miles from Lake Champlain. An old state road from Warren County to Plattsburgh passes through this valley, along which is established the line of interior settlements in this part of the county. Our further rout to the westward was upon a newer and more imperfect road, which has been opened from this place through the unsettled country in the direction of the Black River, in Lewis County. We ascended by this road the woody defiles of the Schroon mountain-ridge, which, as seen from Weatherhead's, exhibits, in its lofty and apparently continuous elevations, little indications of a practicable rout. Having passed a previously unseen gorge of this chain, we continued our way under a heavy rain, till we reached the dwelling of Israel Johnson, who has established himself at the outlet of a beautiful mountain lake, called Clear Pond, nine miles from Schroon river. This is the only dwelling house upon the new road.

To travel in view of the log fences and fallen trees of a thickly wooded country, affords a favorable opportunity for observing the specific spiral direction which is often found in the woody fibre of the stems of forest trees, of various species. In a large proportion of the cases which vary from a perpendicular arrangement, averaging not less than seven out of eight, the spiral turn of the fibres of the stem in ascending from the ground, *is towards the left*, or in popular language, against the sun. It is believed that no cause has been assigned for this by writers on vegetable physiology. The direction, in these cases, coincides with the direction of rotation in our great storms, as well as with that of the tornado which visited New Brunswick in 1835 and other whirlwinds of like character, the traces of which have been carefully examined.

We resumed our journey on the morning of the 15th, and at 9 A. M. reached the Boreas branch of the Hudson, eight miles from Johnson's. Soon after 11 A. M., we arrived at the Main Northern Branch of the Hudson, a little below its junction with the outlet of Lake Sanford. Another quarter of an hour brought us to the landing at the outlet of the lake, nine miles from the Boreas. Taking leave of the "road," we here entered a difficult path which leads up the western side of the lake, and a further progress of six miles brought us to the Iron Works and settlement at McIntyre, where a hospitable reception awaited us.

Settlement at McIntyre.—Mineral Character of the Country.

At this settlement, and in its immediate vicinity, are found beds of iron ore of great, if not unexampled extent, and of the best quality. These deposits have been noticed in the first report of the state geologists, and have since received from Professor Emmons a more extended examination. Lake Sanford is a beautiful sheet of water, of elongated and irregular form, and about five miles in extent. The Iron Works are situated on the north fork of the Hudson, a little below the point where it issues from Lake Henderson, and over a mile above its entrance into Lake Sanford. The fall of the stream between the two lakes is about one hundred feet. This settlement is situated in the upper plain of the Hudson, and at the foot of the principal mountain nucleus, which rises between its sources and those of the Au Sable.

A remarkable feature of this mountain district, is the uniformity of the mineral character of its rocks, which consist chiefly of the dark colored and sometimes opalescent feldspar, known as *labradorite*, or Labrador feldspar. Towards the exterior limits of the formation, this material is accompanied with considerable portions of green augite or pyroxene, but in the more central portions of the formation, this feldspar often constitutes almost the only ingredient of the rocks. It seems not a little repugnant to our notions of the primary rocks, to find a region of this extent which is apparently destitute of mica, quartz, and hornblende, and also, of any traces of stratified gneiss. This labradoritic formation commences at the valley of the Schroon river, and extends westerly into the counties of Hamilton and Franklin, to a limit which is at present unknown. Its northern limit appears to be at the plains which lie between the upper waters of the Au Sable and Lake Placid, and its southern boundary which extends as far as Schroon, has not been well defined. It appears probable that it comprises an area of six or eight hundred square miles, including most of the principal mountain masses in this part of the state. So far as is known to the writer, no foreign rocks or boulders of any size or description are found in this region, if we are not to except as such, the fragments of the dykes, chiefly of trap, by which this rock is frequently intersected.

The surface of the rock where it has been long exposed to the weather, has commonly a whitened appearance, owing to its external decomposition. Blocks and boulders of this rock are scattered over the country in a southerly and westerly direction, as far as the southern boundary of the state, as appears from the Report of Professor Emmons* and other observations, and they are often lodged on the northern declivity of hills, high above the general level of the country. The most eastern of these transported boulders known to the writer, is one of about one hundred tons weight, at Cocksackie, on the Hudson, one hundred and thirty miles south from the labradoritic mountains. This block is found on a hill, three hundred feet above the river, and one hundred and fifty feet above the general level of the adjacent country.

First Expedition to the Mountains.—Encampment.

It has been noticed that the north branch of the Hudson, after its exit from Lake Sanford, joins the main branch of the river, about seven miles below the settlement at McIntyre. Having prepared for an exploration up the latter stream, we left McIntyre on the 17th of July, with three assistants, and the necessary equipage for encampment. Leaving the north branch, we proceeded through the woods in a southeasterly direction, passing two small lakes, till, at the distance of three or four miles from the settlement, we reached the southern point of one of the mountains, and assuming here a more easterly course, we came, about noon, to the main branch of the river. Traces of wolves and deer were frequently seen, and we discovered also the recent tracks of a moose deer or the American elk. We had also noticed on the 16th, at the inlet of Lake Sanford, the fresh and yet undried footsteps of a panther, which apparently had just crossed the inlet.

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* Geological Report, p. 110.

The beaches of the river, on which, by means of frequent fording, we now traveled, are composed of rolled masses of the labradoritic rock, and small opalescent specimens not unfrequently showed their beautiful colors in the bed of the stream. As we approached the entrance of the mountains, the ascent of the stream sensibly increased, and about 4 P. M., preparations were commenced for our encampment. A comfortable hut, of poles and spruce bark, was soon constructed by the exertions of our dexterous woodsmen. The camp-fire being placed on the open side, the party sleep with their heads in the opposite direction, under the lower part of the roof.

On the morning of the 18th we resumed the ascent of the stream by its bed, in full view of two mountains, from between which the stream emerges. About two miles from our camp, we entered the more precipitous part of the gorge through which the river descends. Our advance here became more difficult and somewhat dangerous. After ascending falls and rapids, seemingly innumerable, we came about noon to an imposing cascade, closely pent between two steep mountains, and falling about eighty feet into a deep chasm, the walls of which are as precipitous as those of Niagara, and more secluded. With difficulty we emerged from this gulf, and continued our upward course over obstacles similar to the preceding, till half past 2 P. M., when we reached the head of this terrific ravine. From a ledge of rock which here crosses and obstructs the stream, the river continues, on a level which may be called the Upper Still Water, for more than a mile in a westerly and northwesterly direction, but continues pent in the bottom of a deep mountain gorge or valley, with scarce any visible current. To this point the river had been explored by the proprietors on a former occasion.

Lake Colden.—Mountain Peaks.

Emerging from this valley, we found the river to have a meandering course of another mile, in a northwesterly and northerly direction, with a moderate current, until it forks into two unequal branches. Leaving the main branch which here descends from the east, we followed the northern tributary to the distance of two hundred yards from the forks, where it proved to be the outlet of a beautiful lake, of about a mile in extent. This lake, to which our party afterwards gave the name of Lake Colden, is situated between two mountain peaks which rise in lofty grandeur on either hand. We made our second camp at the outlet of this lake, and in full view of its interesting scenery.

Previous to reaching the outlet, we had noticed on the margin of the river, fresh tracks of the wolf and also of the deer, both apparently made at the fullest speed, and on turning a point we came upon the warm and mangled remains of a fine deer, which had fallen a sacrifice to the wolves; the latter having been driven from their savage repast by our unwelcome approach. There appeared to have been two of the aggressive party, one of which, by lying in wait, had probably intercepted the deer in his course to the lake, and they had nearly devoured their victim in apparently a short space of time.

The great ascent which we had made from our first encampment, and the apparent altitude of the mountain peaks before us, together with the naked condition of their summits, rendered it obvious that the elevation of this mountain group had been greatly underrated; and we were led to regret our want of means for a barometrical measurement. The height of our present encampment above Lake Sanford was estimated to be from ten to twelve hundred feet, and the height of Lake Colden, above tide, at from one thousand eight hundred, to two thousand feet, the elevation of Lake Sanford being assumed from such information as we could obtain, to be about eight hundred feet. The elevation of the peaks on either side of Lake Colden, were estimated from two thousand, to two thousand five hundred feet above the lake. These conclusions were entered in our notes, and are since proved to have been tolerably correct, except as they were founded on the supposed elevation of Lake Sanford, which had been very much underrated.

August 19th. The rain had fallen heavily during the night, and the weather was still such as to preclude the advance of the party. But the ardor of individuals was hardly to be restrained by the storm; and during the forenoon, Mr. Henderson, with John Cheney, our huntsman, made the circuit of Lake Colden, having in their course beaten up the quarters of a family of panthers, to the great discomfiture of Cheney's valorous dog. At noon, the weather being more favorable, Messrs. McIntyre, McMartin and

Hall, went up the border of the lake to examine the valley which extends beyond it in a N. N. E. and N. E. direction, while the writer, with Mr. Henderson, resumed the ascent of the main stream of the Hudson. Notwithstanding the wet, and the swollen state of the stream, we succeeded in ascending more than two miles in a southeasterly and southerly direction, over a constant succession of falls and rapids of an interesting character. In one instance, the river has assumed the bed of a displaced trap dyke, by which the rock has been intersected, thus forming a chasm or sluice of great depth, with perpendicular walls, into which the river is precipitated in a cascade of fifty feet.

Before returning to camp, the writer ascended a neighboring ridge for the purpose of obtaining a view of the remarkably elevated valley from which the Hudson here issues. From this point a mountain peak was discovered, which obviously exceeds in elevation the peaks which had hitherto engaged our attention. Having taken the compass bearing of this peak, further progress was relinquished, in hope of resuming the exploration of this unknown region on the morrow.

Avalanche Lake.—Return to the Settlement.

On returning to our camp, we met the portion of our party which had penetrated the valley north of the lake, and who had there discovered another lake of nearly equal extent, which discharges by an outlet that falls into Lake Colden. On the two sides of this lake, the mountains rise so precipitously as to preclude any passage through the gorge, except by water. The scenery was described as very imposing, and some fine specimens of the opalescent rock were brought from this locality. Immense slides or avalanches had been precipitated into this lake from the steep face of the mountain, which induced the party to bestow upon it the name of Avalanche Lake.

Another night was passed at this camp, and the morning of the 20th opened with thick mists and rain, by which our progress was further delayed. It was at last determined, in view of the bad state of the weather and our short stock of provisions, to abandon any further exploration at this time, and to return to the settlement. Retracing our steps nearly to the head of the Still Water, we then took a westerly course through a level and swampy tract, which soon brought us to the head waters of a stream which descends nearly in a direct course to the outlet of Lake Henderson. The distance from our camp at Lake Colden to McIntyre, by this rout, probably does not exceed six miles. Continuing our course, we reached the settlement without serious accident, but with an increased relish for the comforts of civilization.

This part of the state was surveyed into large tracts, or townships, by the colonial government, as early as 1772, and lines and corners of that date, as marked upon the trees of the forest, are now distinctly legible. But the topography of the mountains and streams in the upper country, appears not to have been properly noted, if at all examined, and in our best maps, has either been omitted or represented erroneously. Traces have been discovered near McIntyre of a rout, which the natives sometimes pursued through this mountain region, by way of Lakes Sanford and Henderson, and thence to the Preston Ponds and the head waters of the Racket. But these savages had no inducement to make the laborious ascent of sterile mountain peaks, which they held in superstitious dread, or to explore the hidden sources of the rivers which they send forth. Even the more hardy huntsman of later times, who, when trapping for northern furs, has marked his path into the recesses of these elevated forests, has left no traces of his axe higher than the borders of Lake Colden, where some few marks of this description may be perceived. All here seems abandoned to solitude; and even the streams and lakes of this upper region are destitute of the trout, which are found so abundant below the cataracts of the mountains.

Whiteface Mountain.—The Notch.

At a later period of the year, Professor Emmons, in the execution of his geological survey, and accompanied by Mr. Hall, his assistant, ascended the Whiteface Mountain, a solitary peak of different formation, which rises in the north part of the county. From this point, Prof. E. distinctly recognized as the highest of the group, the peak on which the writer's attention had been fastened at the termination of our ascent of the Hudson, and which he describes as situated about sixteen miles south of Whiteface. Prof. E. then proceeded southward through the remarkable Notch, or pass, which is described in his Report, and which is situated about five miles north from McIntyre. The Wallface mountain, which forms the west side of the pass, was ascended by him on this occasion, and the height of its perpendicular part was ascertained to be about twelve hundred feet, as may be seen by reference to the geological Report which was published in February last, by order of the legislature. It appears by the barometrical observations made by Prof. Emmons, that the elevation of the table land which constitutes the base of these mountains at McIntyre, is much greater than we had been led to suppose.

Second Journey to Essex County.

The interest excited in our party by the short exploration which has been described, was not likely to fail till its objects were more fully accomplished. Another visit to this alpine region was accordingly made in the summer of the present year. Our party on this occasion consisted of Messrs. McIntyre, Henderson and Hall, (the latter at this time geologist of the western district of the state,) together with Prof. Torrey, Prof. Emmons, Messrs. Ingham and Strong of New York, Miller of Princeton, and Emmons, Jr. of Williamstown.

We left Albany on the 28th of July, and took steamboat at Whitehall on the 29th. At the latter place an opportunity was afforded us to ascend the eminence known as Skeenes' mountain, which rises about five hundred feet above the lake. Passing the interesting ruins of Ticonderoga and the less imposing military works of Crown Point, we again landed at Port Henry and proceeded to the pleasant village of East Moriah, situated upon the high ground, three and a half miles west of the lake. This village is elevated near eight hundred feet above the lake, and commands a fine view of the western slope of Vermont, terminating with the extended and beautiful outline of the Green Mountains.

We left East Moriah on the 31st, and our first day's ride brought us to Johnson's at Clear Pond. The position of the High Peak of Essex was known to be but a few miles distant, and Johnson informed us that the snow remained on a peak which is visible from near his residence, till the 17th of July of the present year. We obtained a fine view of this peak the next morning, bearing from Johnson's, N. 20° West, by compass, a position which corresponded to the previous observations; the variation in this quarter being somewhere between 8° and 9° West.

Descending an abrupt declivity from Johnson's, we arrive at a large stream which issues from a small lake farther up the country, and receiving here the outlet of Clear Pond, discharges itself into the Schroon river. The upper portions of these streams and the lakes from which they issue, as well as the upper course of the Boreas and its mountain lakes, are not found on our maps. From the stream last mentioned, the road ascends the Boreas ridge or mountain chain by a favorable pass, the summit of which is attained about four miles from Johnson's. Between the Boreas and the main branch of the Hudson, we encounter a subordinate extension of the mountain group which separates the sources of the two streams, through the passes of which ridge the road is carried by a circuitous and uneven route.

We reached the outlet of Lake Sanford about noon on the 1st of August, and found two small boats awaiting our arrival. Having embarked we were able fully to enjoy the beauty and grandeur of the lake and mountain scenery which is here presented, all such views being, as is well known, precluded by the foliage while traveling in the forests. The echoes which are obtained at a point on the upper portion of this lake, are very remarkable for their strength and distinctness. The trout are plentiful in this lake, as well as in lake Henderson and all the neighboring lakes and streams. We arrived at McIntyre about 4 P. M., and the resources of the settlement were placed in requisition by the hospitable proprietors, for our expedition to the source of the Hudson.

Barometrical Observations on the Rout.

The following table shows the observations made with the barometer at different points on our rout, and the elevation above tide water as deduced from these observations and others made on the same days at Albany, by Matthew Henry Webster, Esq. No detached thermometer was used, the general exposure of the attached thermometers to the open air being such as to indicate the temperature of the air, at both the upper and lower stations, with tolerable accuracy. In the observations with the mountain barometer a correction is here made for variation in the cistern, equal to one fiftieth of the depression which was found below the zero adjustment at thirty inches.

It is proper also to state, that the two mountain barometers made use of, continued in perfectly good order during our tour, and agreed well with each other in their zero adjustment, which is such as will give a mean annual height of full thirty inches at the sea level; but, like other barometers which have leather bottomed cisterns, are liable to be somewhat affected by damp and warm weather when in the field, and it is possible that this hygrometric depression may have slightly affected some of the observations which here follow.

Date.	Place of observation.	Hour.	Upper station.—Barom. corrected 1-50 for variation of cistern.		Lower station.—60 feet above tide at Albany.		Corrected height in feet, above tide.
			Att. Th.	Barom.	Att. Th.	Barom.	
July 29,	Lake Champlain at White Hall,	9 A. M.	72°	29.91	-	-	90
"	Summit of Skeenes' Mountain at Do.*	8.40 "	71	29.39	-	-	588
"	Lake Champlain at Port Henry,	5 P. M.	73	29.91			
"	East Moriah, Four Corners,†	5.45 "	71	29.09	-	-	880
July 31,	Road summit, 9 miles from Lake Champlain,	10.45 A. M.	71	28.42	72°	29.94	1.546
"	West Moriah, at Weatherhead's, Schroon valley,	1.15 P. M.	75	28.86	75	"	1.117
"	Road summit, pass of Schroon Mountain,	4 "	69	28.57	73	29.93	1.375
"	Johnson's, at Clear Pond,	5.50 "	67	27.93	72	"	2.012
Aug. 1,	Do. Do. Second observation,‡	6.20 A. M.	62	28 03	70	30.04	1.991
"	Road summit, ridge west of Johnson's,	8 "	64	27.45	71	"	2.592
"	Boreas River bridge,	9.45 "	69	28.01	73	30.02	2.026
"	Hudson River bridge,	12.30 P. M.	78	28.19	79	29.95	1.810
"	Lake Sanford inlet,	4 "	76	28.17	78	"	1.826
"	Iron Works at McIntyre,	4.20 "	76	28.11	77	"	1.889
"	Lake Henderson outlet,	4.40 "	75	28.06	76	"	1.936

Lake Champlain is about ninety feet above tide water.

It appears from the above that the two principal depressions in the section of country over which this road passes, west of the Schroon valley, is in one case two thousand and in the other eighteen hundred feet in elevation.

Second Expedition to the Mountains.

We left the settlement on the 3d of August, with five woodsmen as assistants, to take forward our provisions and other necessaries, and commenced our ascent to the higher region in a northeasterly direction, by the rout on which we returned last year. We reached our old camp at Lake Colden at 5 P. M. where we prepared our quarters for the night. The mountain peak which rises on the eastern side of this lake and separates it from the upper valley of the main stream of the Hudson, has received the name of Mount McMartin, in honor of one now deceased, who led the party of last year, and whose spirit of enterprise and persevering labors contributed to establishing the settlement at the great Ore Beds, as well as other improvements advantageous to this section of the state.

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* Four hundred and ninety eight feet above Lake Champlain.

† Seven hundred and ninety feet above do.

‡ Mean of the two setts of observations two thousand feet, nearly.

On the 4th we once more resumed the ascent of the main stream, proceeding first in an easterly direction, and then to the southeast and south, over falls and rapids, till we arrived at the head of the Great Dyke Falls. Calcedony was found by Prof. Emmons near the foot of these falls. Continuing our course on a more gradual rise, we soon entered upon unexplored ground, and about three miles from camp, arrived at the South Elbow, where the bed of the main stream changes to a northeasterly direction, at the point where it receives a tributary which enters from south-southwest. Following the former course, we had now fairly entered the High Valley which separates Mount McMartin from the High Peak on the southeast, but so deeply enveloped were we in the deep growth of forest, that no sight of the peaks could be obtained. About a mile from the South Elbow we found another tributary entering from south-southeast, apparently from a mountain ravine which borders the High Peak on the west. Some beautifully opalescent specimens of the Labradorite were found in the bed of this stream.

High Valley of the Hudson.

Another mile of our course brought us to a smaller tributary from the north, which from the alluvial character of the land near its entrance is called the High Meadow fork. This portion of our rout is in the center of this mountain valley, and has the extraordinary elevation of three thousand and seven hundred feet above tide. We continued the same general course for another mile, with our rout frequently crossed by small falls and cascades, when we emerged from the broader part of the valley and our course now became east-southeast and southeast, with a steeper ascent and higher and more frequent falls in the stream. The declivity of the mountain which incloses the valley on the north and that of the great peak, here approximate closely to each other, and the valley assumes more nearly the character of a ravine or pass between two mountains, with an increasing ascent, and maintains its course for two or three miles, to the summit of the pass. Having accomplished more than half the ascent of this pass we made our camp for the night, which threatened to be uncommonly cold and caused our axemen to place in requisition some venerable specimens of the white birch which surrounded our encampment,

Phenomena of Mountain Slides.

A portion of the deep and narrow valley in which we were now encamped, is occupied by a longitudinal ridge consisting of boulders and other *debris*, the materials, evidently, of a tremendous slide or avalanche, which at some unknown period has descended from the mountain; the momentum of the mass in its descent having accumulated and pushed forward the ridge, after the manner of the late slide at Troy, beyond the center of the valley or gorge into which it is discharged. It appears indeed that the local configuration of surface in these mountain valleys, except where the rock is in place, ought to be ascribed chiefly to such causes. It seems apparent, also, that the Hudson, at the termination of its descent from the High Valley, once discharged itself into Lake Colden, the latter extending southward at that period to the outlet of the Still Water, which has been noticed in our account of the former exploration. This portion of the ancient bed of the lake has not only been filled and the bed of the stream as well as the remaining surface of the lake, raised above the former level, but a portion of the finer *debris* brought down by the main stream, has flowed northwardly into the present lake and filled all its southern portions with a solid and extensive shoal, which is now fordable at a low stage of the water. The fall of heavy slides from the mountains appears also to have separated Avalanche Lake from Lake Colden, of which it once formed a part, and so vast is the deposit from these slides as to have raised the former lake about eighty feet above the surface of the latter. In cases where these slides have been extensive, and rapid in their descent, large hillocks or protuberances are formed in the valleys; and the denudation from above, together with the accumulation below, tends gradually to diminish the extent and frequency of their occurrence. But the slides still recur, and their pathway may often be perceived in the glitter of the naked rock, which is laid bare in their course from the summit of the mountain towards its base, and these traces constitute one of the most striking features in the mountain scenery of this region.

Main Source of the Hudson.—Fall of the Au Sable.

On the morning of the fifth we found that ice had formed in exposed situations. At an early hour we resumed our ascending course to the southeast, the stream rapidly diminishing and at length becoming partially concealed under the grass-covered boulders. At 8.40 A. M. we arrived at the head of the stream on the summit of this elevated pass, which here forms a beautiful and open mountain meadow, with the ridges of the two adjacent mountains rising in an easy slope from its sides. From this little meadow, which lies within the present limits of the town of Keene, the main branch of the Hudson and a fork of the east branch of the Au Sable commence their descending course in opposite directions, for different and far distant points of the Atlantic ocean. The elevation of this spot proves by our observations to be more than four thousand seven hundred feet above tide water; being more than nine hundred feet above the highest point of the Catskill mountains, which have so long been considered the highest mountains in this state.

The descent of the Au Sable from this point is most remarkable. In its comparative course to Lake Champlain, which probably does not exceed forty miles, its fall is more than four thousand six hundred feet! This, according to our present knowledge, is more than twice the entire descent of the Mississippi proper, from its source to the ocean. Water-falls of the most striking and magnificent character are known to abound on the course of this stream.

High Peak of Essex.

Our ascent to the source of the Hudson had brought us to an elevated portion of the highest mountain peak, which was also a principal object of our exploration, and its ascent now promised to be of easy accomplishment by proceeding along its ridge in a W. S. W. direction. On emerging from the pass, however, we immediately found ourselves entangled in the zone of dwarfish pines and spruces, which with their numerous horizontal branches interwoven with each other, surround the mountain at this elevation. These gradually decreased in height, till we reached the open surface of the mountain, covered only with mosses and small alpine plants, and at 10 A. M. the summit of the High Peak of Essex was beneath our feet.

The aspect of the morning was truly splendid and delightful, and the air on the mountain-top was found to be cold and bracing. Around us lay scattered in irregular profusion, mountain masses of various magnitudes and elevations, like to a vast sea of broken and pointed billows. In the distance lay the great valley or plain of the St. Lawrence, the shining surface of Lake Champlain, and the extensive mountain range of Vermont. The nearer portions of the scene were variegated with the white glare of recent mountain slides as seen on the sides of various peaks, and with the glistening of the beautiful lakes which are so common throughout this region. To complete the scene, from one of the nearest settlements a vast volume of smoke soon rose in majestic splendor, from a fire of sixty acres of forest clearing, which had been prepared for the "burning," and exhibiting in the vapor which it embodied, a gorgeous array of the prismatic colors, crowned with the dazzling beams of the midday sun.

The summit, as well as the mass of the mountain, was found to consist entirely of the labradoritic rock, which has been mentioned as constituting the rocks of this region, and a few small specimens of hypersthene were here procured. On some small deposits of water, ice was also found at noon, half an inch in thickness. The source of the Hudson, at the head of the High Pass, bears N. 70° E. from the summit of this mountain, distant one and a quarter miles, and the descent of the mountain is here more gradual than in any other direction. Before our departure we had the unexpected satisfaction to discover, through a depression in the Green Mountains, a range of distant mountains in nearly an east direction, and situated apparently beyond the valley of the Connecticut; but whether the range thus seen, be a portion of the White Mountains of New Hampshire or the mountains of Franconia, near the head of the Merrimack, does not fully appear. Our barometrical observations on this summit show an elevation of five thousand four hundred and sixty seven feet. This exceeds by about six hundred feet, the elevation of the Whiteface Mountain, as given by Prof. Emmons; and is more than sixteen hundred and fifty feet above the highest point of the Catskill Mountains.

Wear of River Boulders.

The descent to our camp was accomplished by a more direct and far steeper rout than that by which we had gained the summit, and our return to Lake Colden afforded us no new objects of examination. The boulders which form the bed of the stream in the upper Hudson, are often of great magnitude, but below the mountains, where we commenced our exploration last year, the average size does not much exceed that of the paving stones in our cities;—so great is the effect of the attrition to which these boulders are subject in their gradual progress down the stream. Search has been made by the writer, among the gravel from the bottom and shoals of the

Hudson near the head of tide-water, for the fragmentary remains of the labradoritic rock, but hitherto without success. We may hence infer that the whole amount of this rocky material, which, aided by the ice, and the powerful impulse of the annual freshets, finds its way down the Hudson, a descent of from two thousand to four thousand seven hundred feet, is reduced by the combined effects of air, water, frost, and attrition, to an impalpable state, and becomes imperceptibly deposited in the alluvium of the river, or continuing suspended, is transferred to the waters of the Atlantic.

Great Trap Dyke.

On the 7th of August we visited Avalanche Lake, and examined the great dyke of sienitic trap in Mount McMartin, which cuts through the entire mountain in the direction from west-northwest to east-southeast. This dyke is about eighty feet in width, and being in part broken from its bed by the action of water and ice, an open chasm is thus formed in the abrupt and almost perpendicular face of the mountain. The scene on entering this chasm is one of sublime grandeur, and its nearly vertical walls of rock, at some points actually overhang the intruder, and seem to threaten him with instant destruction. With care and exertion this dyke may be ascended, by means of the irregularities of surface which the trap rock presents, and Prof. Emmons by this means accomplished some twelve or fifteen hundred feet of the elevation. His exertions were rewarded by some fine specimens of hypersthene and of the opalescent labradorite, which were here obtained. The summit of Mount McMartin is somewhat lower than those of the two adjacent peaks, and is estimated at four thousand nine hundred and fifty feet above tide.

The distance from the outlet of Lake Colden to the opposite extremity of Avalanche Lake is estimated at two and a quarter miles. The stream which enters the latter at its northern extremity, from the appearance of its valley, is supposed to be three-fourths of a mile in length, and the fall of the outlet in its descent to Lake Colden is estimated, as we have seen, at eighty feet. The head waters of this fork of the Hudson are hence situated farther north than the more remote source of the Main Branch, which we explored on the 4th and 5th, or perhaps than any other of the numerous tributaries of the Hudson. The elevation of Avalanche Lake is between two thousand nine hundred and three thousand feet above tide, being undoubtedly the highest lake in the United States, east of the Rocky Mountains.

The mountain which rises on the west side of this lake and separates its valley from that of the Au Sable, is perhaps the largest of the group. Its ridge presents four successive peaks, of which the most northern save one, is the highest, and is situated immediately above the lake and opposite to Mount McMartin. It has received the name of Mount McIntyre, in honor of the late Controller of this state, to whose enterprise and munificence, this portion of the country is mainly indebted for the efficient measures which have been taken to promote its prosperity.

Ascent of Mount McIntyre.

On the morning of the 8th, we commenced the ascent of Mount McIntyre through a steep ravine, by which a small stream is discharged into Lake Colden. The entire ascent being comprised in little more than a mile of horizontal distance, is necessarily difficult, and on reaching the lower border of the belt of dwarf forest, we found the principal peak rising above us on our right, with its steep acclivity of naked rock extending to our feet. Wishing to shorten our rout, we here unwisely abandoned the remaining bed of the ravine, and sustaining ourselves by the slight inequalities of surface which have resulted from unequal decomposition, we succeeded in crossing the apparently smooth face of the rock by an oblique ascent to the right, and once more obtained footing in the woody cover of the mountain. But the continued steepness of the acclivity, and the seemingly impervious growth of low evergreens on this more sheltered side, where their horizontal and greatly elongated branches were most perplexingly intermingled, greatly retarded our progress. Having surmounted this region we put forward with alacrity, and at 1 P. M. reached the summit.

The view which was here presented to us differs not greatly in its general features from that obtained at the High Peak, and the weather, which now began to threaten us with a storm, was less favorable to its exhibition. A larger number of lakes were visible from this point, and among them the beautiful and extensive group at the sources of the Saranac, which are known by the settlers as the "Saranac Waters." The view of the Still Water of the Hudson, lying like a silver thread in the bottom of its deep and forest-green valley, was peculiarly interesting. The opposite front of Mount McMartin exhibited the face of the great dyke and its passage through the summit, near to its highest point, and nearly parallel to the whitened path of a slide which had recently descended into Avalanche Lake. In a direction a little south of west, the great vertical precipice of the Wallface Mountain at the Notch, distinctly met our view. Deeply below us on the northwest and north, lay the valley of the west branch of the Au Sable, skirted in the distance by the wooded plains which extend in the direction of Lake Placid and the Whiteface Mountain.

Mount McIntyre is also intersected by dykes, which cross it at the lowest points of depression between its several peaks, and the more rapid erosion and displacement of these dykes has apparently produced the principal ravines in its sides. The highest of these peaks on which we now stood, is intersected by cracks and fissures in various directions, apparently caused by earthquakes. Large blocks of the same labradoritic rock as the mass of the mountain, lay scattered in various positions about the summit, which afforded nearly the same growth of mosses and alpine plants as the higher peak visited on the 5th. Our barometric observations show a height of near five thousand two hundred feet, and this summit is probably the second in this region, in point of elevation. There are three other peaks lying in a westerly direction, and also three others lying eastward of the main source of the Hudson, which nearly approach to, if they do not exceed, five thousand feet in elevation, making of this class, including Mount McMartin, Whiteface, and the two peaks visited, ten in all. Besides these mountains there are not less than a dozen or twenty others that appear to equal or exceed the highest elevation of the Catskill group.

Visit to the Great Notch.—Return to the Settlement.

The descent of the mountain is very abrupt on all sides, and our party took the rout of a steep ravine ,which leads into the valley of the Au Sable, making our camp at night-fall near the foot of the mountain. The night was stormy, and the morning of the 9th opened upon us with a continued fall of rain, in which we resumed our march for the Notch, intending to return to the settlement by this rout. After following the bed of the ravine till it joined the Au Sable, we ascended the latter stream, and before noon arrived at this extraordinary pass, which has been described by the state geologists, and which excites the admiration of every beholder. Vast blocks and fragments have in past ages fallen from the great precipice of the Wallface Mountain on the one hand, and from the southwest extension of Mount McIntyre on the other, into the bottom of this natural gulf. Some of these blocks are set on end, of a height of more than seventy feet, in the moss-covered tops and crevices of which, large trees have taken root, and now shoot their lofty stems high above the toppling foundation. The north branch of the Hudson, which passes through Lakes Henderson and Sanford, takes its rise in this pass, about five miles from McIntyre, and the elevation of its source, as would appear from the observations taken by Prof. Emmons last year, is not far from three thousand feet above tide.

Following the course of the valley, under a most copious fall of rain, we descended to Lake Henderson, which is a fine sheet of water of two or three miles in length, with the high mountain of Santanoni rising from its borders, on the west and southwest. It is not many months since our woodsman, Cheney, with no other means of offense than his axe and pistol, followed and killed a large panther, on the western borders of this lake. Pursuing our course along the eastern margin of this lake, we arrived at the settlement about 3 P. M., having been absent on our forest excursion seven days.

Elevation of the Mountain Region.

The following table of observations, as also the preceding one, is calculated according to the formula given by Bowditch in his Navigator, except for the two principal mountain peaks, which are calculated by the formula and tables of M. Oltmanns, as found in the appendix to the Geological Manual of De la Beche, Philadelphia edition. For the points near Lake Champlain, the height is deduced from the observations made at the lake shore, instead of those at Albany, adding ninety feet for the height of Lake Champlain above tide. The barometrical observations made at Syracuse, N. Y., at the same periods, by V. W. Smith, Esq., (with a well adjusted barometer, which has been compared with those of the writer,) would give to the High Peak an elevation of five thousand five hundred and ten feet. The observations at Albany have been taken for the lower station, because the latter place is less distant, and more nearly on the same meridian. Perhaps the mean of the two results may with propriety be adopted. In most of the other cases, the results deduced from the observations at Albany agree very nearly with the results obtained from the observations made at Syracuse.

Date.	Place of observation.	Hour.	Upper station.—Barom. corrected 1-50 for variation of cistern.		Lower station.—60 feet above tide at Albany.		[illegible]
			Att. Th.	Barom.	Att. Th.	Barom.	
Aug. 3,	Lake Colden outlet,	5.30 P. M.	70°	27.00	74°	29.75	[illegible]
Aug. 4,	Hudson River, above the Dyke Falls,	12.30 "	74	26.72	72	29.97	[illegible]
"	Do. in High Valley, E. of Mt. McMartin,	2.30 P. M.	72	26.37	73	29.96	[illegible]
"	Do. one third mile above camp, in the High Pass,	4.30. "	52	25.66	72	29.97	[illegible]
Aug. 6,	Head of the High Pass, source of the main branch of the Hudson and a fork of the east branch of the Au Sable,	8.40 A. M.	47	25.43	64	30.20	[illegible]
"	Summit of the High Peak of Essex, one and a quarter miles S. 70° W. from the source of the Hudson,	1 P. M.	47	24.83	69	30.24	[illegible]
Aug. 8,	Summit of Mount McIntyre, between Lake Colden and West branch of the Au Sable,	1.30 P. M.	60	25.11	73	30.14	[illegible]
Aug. 12,	Summit of Bald Peak,* on the west shore of Lake Champlain, six miles N. 29° W. from Crown Point,	11 A. M.	65	27.99			[illegible]
"	Lake Champlain at Port Henry,	4 P. M.	75	30.02			
	Do. corrected as for 11 A. M.	- -	73	30.03			

View of Lake Champlain.—Routs to the Head of the Hudson.

Bald Peak is the principal eminence on the western shore of Lake Champlain, about seven miles N. N. W. from Crown Point, and was ascended by the writer on our return to the lake. A good carriage road leads from East Moriah nearly to the foot of the peak, from whence the ascent by a footpath is not difficult, and may be accomplished even by ladies, without hazard. The summit commands a good view of some of the principal peaks in the interior, and the prospect of the prolonged basin of Lake Champlain, which is obtained from this point, is well worth the trouble of the ascent, and is worthy the attention of tourists who can find it convenient to land either at Port Henry or Westport.

The source of the Hudson and the High Peak of Essex, can be most conveniently reached from Johnson's, at Clear Pond, by a course N. 20° W.; or by landing at Westport, or Essex and proceeding to the nearest settlement in Keene. By landing at Port Kent, and ascending the course of the Au Sable to the southeast part of Keene, and from thence to the Peak, the most interesting chain of waterfalls and mountain ravines that is to be found, perhaps, in the United States, may be visited. At Keene, Mr. Harvey Holt, an able woodsman, who was attached to our party, will cheerfully act as guide and assistant, in reaching the mountain. From the valley which lies southward of the peak, and near to the head waters of the Boreas and Au Sable, may be obtained, it is said, some of the best mountain views which this region affords. But travelers in these wilds, must be provided with their own means of subsistence, while absent from the settlements.

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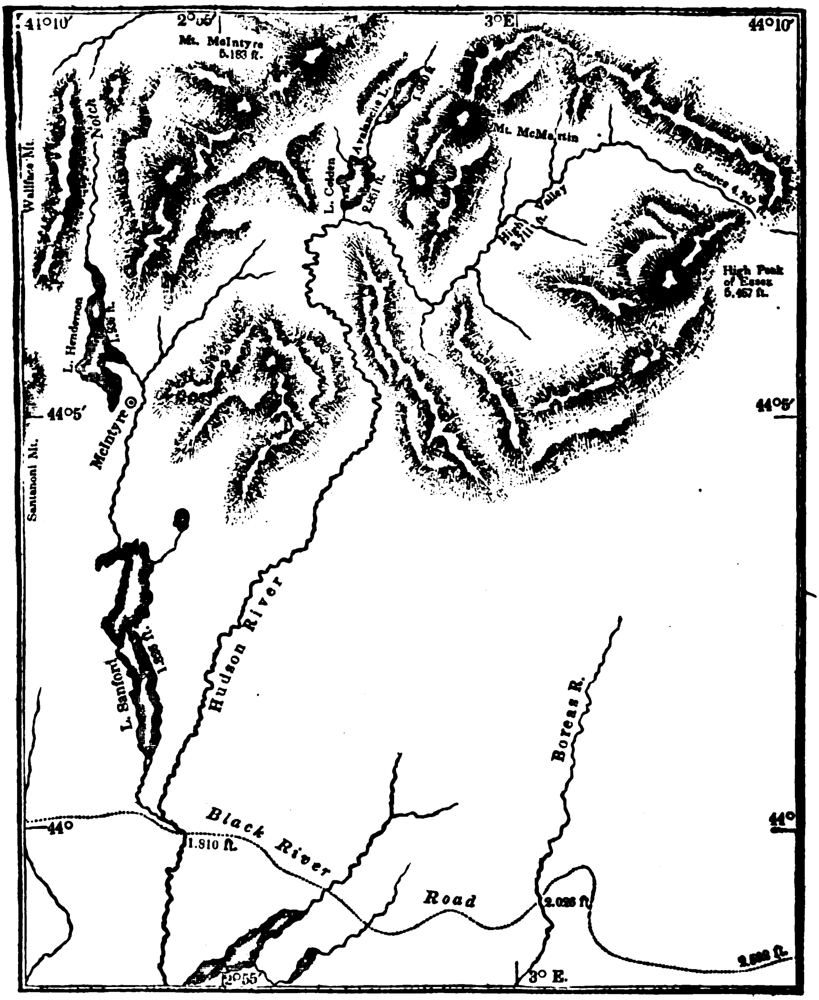
* 1975 feet above Lake Champlain.



The above sketch must be considered only as an approach to correctness of topography, and is based in part upon the survey lines, as found on the County map; but the geographical position is approximated to Burr's Map of the State of New York, by means of bearings from known objects on the borders of Lake Champlain.

Mountains of New Hampshire.

The only point east of the Mississippi which is known to exceed this group of mountains in elevation, is the highest summit of the White Mountains in New Hampshire; the elevation of which is given by Prof. Bigelow from barometrical observations, reduced by Prof. Farrar, at six thousand two hundred and twenty-five feet.* Prof. Bigelow adduces the observations of Capt. Partridge, made several years since, as giving an elevation of only six thousand one hundred and three feet. But the writer is indebted to Dr. Barratt for a memorandum of observations made by Capt. Partridge in August, 1821, which gives the height of the principal peaks of the New Hampshire group, as follows:

Mount	Washington,	above the	sea,	6.234 feet.
"	Adams,	"	"	5.328
"	Jefferson,	"	"	5.058
"	Madison,	"	"	4.866
"	Franklin,	"	"	4.711
"	Monroe,	"	"	4.356

From this it appears most probable that there are a greater number of peaks in the Essex group that exceed five thousand feet, than in New Hampshire; although the honor of the highest peak is justly claimed by the latter.

Imperfect State of Geographical knowledge—Resources of the Mountain District.

It appears unaccountable, that the elevation of this region at the sources of the Hudson should have been, hitherto, so greatly underrated. Even Darby, in his admirable work on American geography, estimates the fall of the rivers which enter Lake Champlain from the west, as similar to those on the east, which he states to be from five hundred to one thousand feet.† The same writer also estimates the height of the table land from which the Hudson flows, at something more than one thousand feet !‡ The mountains of this region, appear to have almost escaped the notice of geographical wtiters, and in one of our best Gazetteers, that of Darby and Dwight, published in 1833, the elevation of the mountains in Essex county, is stated at one thousand two hundred feet. In Macauley's History of New York, published in Albany in 1829, there is, however, an attempt to describe the mountains of the Northern district of the State, by dividing them into six distinct ranges. This description is necessarily imperfect, as regards the central portion of the group; but this author appears to have more nearly appreciated the elevation of these mountains than any former writer. He states the elevation of Whiteface at two thousand six hundred feet, and the highest part of the most westerly or Chateaugua range at three thousand feet. To the mountains near the highest source of the Hudson, including probably the High Peak, he has given the name of the Clinton range, and has estimated their elevation from six hundred, to two thousand feet![*] He also describes the West Branch of the Hudson which rises near the eastern border of Herkimer county, as being the principal stream. The Northwest Branch, which unites with the main North Branch, a few miles below Lake Sanford, he describes as rising on the borders of Franklin and Essex counties and as pursuing a more extended course than the North Branch. Perhaps this description may be found correct, although information received from other sources does not seem to confirm this position.

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* New England Journal of Medicine and Surgery, Vol. V., p. 330.

† Darby's View of the U. S. p. 242.

‡ Ib. p. 140.

It is understood that Prof. Emmons, in pursuing his geological explorations, has ascended another of the principal peaks situated easterly of the highest source of the Hudson, and made other observations which will be of value in settling the geography of this region. The Professor finds the northern district of the state, to be one of great interest to the geologist, and although from the deficiencies of our maps, he is constrained to the performance of duties which pertain to the geographical, rather than to the geological department of science, yet all that can be accomplished in either branch, with the means placed at his disposal, may be confidently expected from his discriminating zeal and untiring perseverance.

Owing, perhaps, to the soda and lime which are constituents of the labradoritic rock, and its somewhat easy decomposition when exposed to the action of the elements, the soil of this region is quite favorable to the growth of the forests as well as the purposes of agriculture. The beds of iron ore which are found on the waters of the Hudson, at McIntyre, probably surpass in richness and extent, any that have been discovered in other countries. In future prospect, this region may be considered as the Wales of the American continent, and with its natural resources duly improved, it will, at no distant period, sustain a numerous and hardy population.

New York, November 1, 1837.

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[*] Macauley's History of New York, Vol. i., pp. 2 to 9 and 20, 21. Albany, 1829.

ART. XV.—*Contributions to English Lexicography;* by Prof. J. W. GIBBS.

No. I. Account of some Arabic Words found in English.

Abuna, (Arab. أَبُونَا, Ethiop. አቡነ : *our father;* comp. Heb. אֲבִינוּ;) the title of Christian priests in Syria; also of the primate of Abyssinia.

Al, (Arab. اَلْ *the;* comp. Heb. הַ, for הַל;) a prefix to many words derived from the Arabic, which, however, has amalgamated with the noun itself, and lost its original significancy; as, *alcaid, alchimy, alkoran*, etc.

Alcaid, (Arab. قَائِد *a governor*, with pref. اَلْ *the*, from قَادَ *to lead, govern;*) a name of office among the Moors, Spaniards and Portuguese. This word is not to be confounded with *cadi*, which has an entirely different origin.

Alchimy, (Arab. كِيمِيَا *kimia*, as if *the hidden art*, with pref. اَلْ *the*, from كَمَى *to hide;*) the more sublime and difficult parts of chimistry. Comp. *chimistry*. It is remarkable that Richardson adheres to the old derivation from Gr. χέω.

Alcohol, (Arab. كُحْلٌ a pigment for the eyes made of the black oxyd of antimony, with pref. اَلْ *the*, from كَحَلَ *to blacken* or *paint* the eyes; comp. Heb. כָּחַל idem;) *pure spirits*. However difficult it may be to show the connection between *a pigment of antimony* and *pure spirits;* yet the fact of the connection is evident from Span. *alcohol*, which unites these two significations.

Alcove, (Arab. قُبَّةٌ kubba, *an arch*, with pref. اَلْ *the*, from قَبَّ conj. ii. *to construct with an arch;* comp. Heb. קֻבָּה *a chamber, dormitory*, so called because *arched*, from קָבַב *to make curved* or *hollow;*) *a recess in a chamber to sit or lie in;* hence *a recess in a library*.

Aldebaran, (Arab. اَلدَّبَرَان liter. *the follower*, scil. of the Pleiades, from دَبَرَ *to follow;* comp. Heb. דָּבַר idem;) a star of the first magnitude in the southern eye of the constellation Taurus.

Alembic, (Arab. أنبيق or أنبيك a chimical vessel for distillation, with pref. أل *the;*) a chimical vessel for distillation.

Algebra, (Arab. جبر *the reduction of parts to a whole*, or *of fractions to a whole number*, with pref. أل *the*, from جبر *to bind up, to consolidate, to make whole;* comp. Heb. גָּבַר *to be strong*, as if *to be girded;*) *universal arithmetic, a general mode of computing by signs.* Richardson has given the Arabic word incorrectly.

Alkali, (Arab. قلي the ashes of a plant called *glass-wort*, from which alkali is obtained, with pref. أل *the*, from قلي *to fry;* comp. Heb. קָלָה *to roast;*) the name of a peculiar class of chimical substances.

Alkoran, (Arab. قرآن liter. *a reading*, with pref. أل *the*, from قرأ *to read;* comp. Heb. קָרָא *to cry, to call, to read;*) the sacred book of the Mohammedans. Also called *koran*, q. v.

Almagest, (Arab. magest = Gr. μέγιστος, *greatest*, with pref. أل *the;*) the name of an astronomical work by Ptolemy.

Almanac, (Arab. مناخ *a diary, calendar*, with pref. أل *the;*) *a diary, calendar.*

Cadi, (Arab. قاضي *a judge*, from قضي *to decide, judge;* comp. Heb. קָצָה *to cut off, to judge;*) among the Mohammedans, *an inferior judge.* This word is not to be confounded with *alcaid*, which has an entirely different origin.

Caliph, (Arab. خليفة khalipha, *a successor, vicegerent*, from خلف *to succeed;* comp. Heb. חָלַף *to pass along, to succeed;*) a title given to the successors of Mohammed.

Chimistry, (Arab. كيميا kimia, as if *the hidden art*, from كمي *to hide;*) the science which teaches the nature of bodies. In usage it is distinguished from *alchimy*, q. v.

Coffee, (Arab. قهوة kahwa, *wine*, also *a decoction of coffee*, from قهي conj. iv. *to drink frequently;*) the name of a berry, and of a drink made from it.

Cotton, (Arab. قُطْنٌ *cotton;* comp. كَتَّنٌ *linen*, also Heb. כְּתֹנֶת *a tunic;*) a soft, downy substance obtained from a plant.

Dragoman, (Arab. تُرْجُمَانٌ targoman, *an interpreter*, from تَرْجَمَ *to interpret;* comp. Chald. תַּרְגֵּם idem;) in the east, *an interpreter.*

Emir, (Arab. أَمِيرٌ *a commander, prince*, from أَمَرَ *to command;* comp. Heb. אָמַר *to say*, also *to command;*) in Turkey, a title of honor given to those who claim descent from Mohammed. The form *omrahs*, which is derived from the Arabic plural أُمَرَاءُ by annexing *s*, is not to be imitated.

Fetwa, (Arab. فَتْوَى *a legal decision* or *answer*, from فَتَا conj. iv. *to give a legal decision*; comp. Heb. פָּתַח *to open;*) *a written decision of the mufti.* Comp. *mufti.*

Hajji, (Arab. حَاجِّيٌّ *a pilgrim to Mecca*, from حَجَّ *to go on a pilgrimage to Mecca;* comp. Heb. חָגַג *to move round in a circle, to dance, to celebrate a festival;*) *a Mohammedan pilgrim.*

Harem, (Arab. حَرَمٌ *a sanctuary, a woman's apartment*, from حَرَمَ *to prohibit;* comp. Heb. חָרַם primar. *to shut up, to prohibit;*) in the east, *the woman's apartment.*

Hegira, (Arab. هِجْرَةٌ hijra, *flight, leaving one's country*, from هَجَرَ *to fly;* comp. Heb. הָגַר idem;) the flight of Mohammed from Mecca to Medina, from which the Mohammedans reckon time.

Imam, (Arab. إِمَامٌ *a priest*, from أَمَّ *to go before, to lead in sacred rites;*) *a Mohammedan priest.* The form *iman* is incorrect.

Islam, (Arab. إِسْلَامٌ liter. *devotion* or *submission*, scil. to God and his prophet Mohammed, hence *the Mohammedan religion*, from سَلَمَ conj. ii. *to submit to God;* comp. Heb. שָׁלַם *to be sound*, Hiph. *to make peace by submission;*) *the Mohammedan religion.* Comp. *Moslem* and *Musulman*, which are from the same root.

Islamism, the preceding word with the Greek termination *ism.*

Kebla, (Arab. قبلة *the region in front of a person, the direction of a person's face in prayer*, from قبل *to meet;* comp. Heb. קָבַל *to be before*, or *over against;*) *the direction of a person's face in prayer.*

Koran, in usage the same as *Alkoran*, q. v.

Mamluk, (Arab. مملوك *possessed, a slave;* pass. part. from ملك *to possess, rule;* comp. Heb. מָלַךְ *to reign;*) in the east, a kind of mercenary soldier.

Minaret, (Arab. منارة *a place for a light, the turret of a Mohammedan temple*, from نار *to shine;* comp. Heb. נור idem;) *the tower of a Mohammedan temple.*

Mohammed, (Arab. محمد *praised*, also *Mohammed*, from حمد *to praise;* comp. Heb. חָמַד *to desire earnestly;*) the proper name of the Arabian impostor.

Molla, (Arab. مولي maula, *a president, lord*, from ولي *to preside, govern;*) among the Mohammedans, *a superior judge.*

Mosk, (Arab. مسجد masjid, *a temple*, from سجد *to incline the head, to worship;* comp. Heb. סָגַד idem;) *a Mohammedan temple.*

Moslem, (Arab. مسلم *one devoted to God and his prophet Mohammed, a Mohammedan*, from سلم conj. ii. *to submit to God;* comp. *islam* above;) *a Mohammedan.*

Mufti, (Arab. مفتي *one who decides cases of Mohammedan law*, from فتا conj. ii. *to give a legal decision;* comp. *fetwa* above;) in Turkey, *the chief minister of religion and law.*

Musulman, the Persian form of the Arabic word *moslem.* The plural form *musulmen* has arisen from mistake and is incorrect.

Rais, (Arab. رئيس *a captain*, from رأس *to be head or chief;* comp. Heb. ראשׁ *the head;*) in the east, *the captain of a ship.*

Ramadan, (Arab. رمضان;) the month of fasting among the Arabians.

Sheikh, (Arab. شَيْخ *an old man*, also a name of office, from شَاخ *to be old;*) among the Arabians and Moors, *a man of eminence.*

Sherif, (Arab. شَرِيف *noble*, from شَرُف *to be noble;* comp. Heb. שָׂרַף idem;) a title of honor given to the descendants of Mohammed.

Sultan, (Arab. سُلْطَان *a prince, ruler*, from سَلَط *to rule;* comp. Heb. שָׁלַט idem;) the title of the emperor of Turkey.

Wadi, (Arab. وَادٍ;) *a torrent* or *bed of a river.*

Vizier, (Arab. وَزِير liter. *one loaded with business*, from وَزَر *to bear;* comp. Heb. וָזַר idem;) among the Mohammedans, *a minister of state.*

ART. XVI.—*Lectures and Remarks of* DR. GIDEON MANTELL.

No. 1.

WE have received, from time to time, printed notices of the admirable lectures of Dr. Mantell on geology and other subjects, delivered at Brighton, England, and printed, (in an abridged form,) in the papers of that town.

Like all the productions of that highly gifted and enlightened man, they are replete with accurate science, with enlarged views of the relations of things, and with happy moral applications. We have, for some time, intended to publish in this Journal, parts of these lectures, and occasionally to give them entire, believing that we can in no way gratify and instruct our readers more effectually in the sciences of which they treat. To the adept, they will prove an interesting review, and to the student and especially the young lecturer, they will afford a fine model of a condensed, perspicuous and beautiful style, with as much of accurate science as can well be communicated in a popular lecture.

We are happy also in the opportunity of paying, (consistently with the plan of our work,) this mark of respect to a gentleman who is an ornament to his country, and to whom science, especially geology, comparative anatomy, and paleontology are greatly indebted. —ED.

Dr. Mantell's Lecture on Zoophytes.

The subject* (says the reporter) which he had selected for illustration, was one of peculiar interest, and yet perhaps less understood by the general observer, than any other department of natural science; nor was this surprising, when we considered that notwithstanding the press had poured out books on natural history in such abundance and variety as absolutely to retard the progress of knowledge by the overwhelming mass of materials, yet there existed not in our language one good elementary work on that wonderful division of the animal kingdom which it was the purpose of his present attempt to elucidate. If it be necessary (said Dr. M.) for me on this, as on previous occasions, to defend investigations of this nature from the charge of inutility or frivolity, and answer the question—"To what practical end and advantage do such researches tend?" I might refer to the history of all science, where speculations even the most unprofitable, have invariably led to great practical benefits. But I will take a higher ground, and, in the language of a philosopher alike the pride of our country and the admiration of Europe, assert, that there is a lofty and disinterested pleasure in scientific pursuits which ought to exempt them from such questioning. "Communicating as they do to the mind the purest happiness, after the exercise of the benevolent and religious feelings, of which our nature is susceptible, I would allege *this* as a sufficient and direct reply to those who having themselves little capacity and less relish for intellectual pursuits, are constantly repeating this inquiry." The natural philosopher, accustomed to trace the operations of the laws which the Creator has established, in circumstances where the uninformed and unenquiring eye perceives neither novelty nor beauty, walks in the midst of wonders; every object which falls in his way elucidates some principle, affords some instruction, and impresses him with a sense of harmony and order, and of deep humility and dependence. Nor is it one of the least advantages of these pursuits that they are independent of external circumstances, and may be enjoyed in every situation of life; the calm and dispassionate interest with which they fill the mind, renders them a most delightful retreat from the agitations and dissensions of the world, and from the conflict of passions, prejudices, and interests in which we all find ourselves continually involved; in short, by directing our attention to the investigation of natural phenomena, we may realize the beautiful fiction of our immortal Shakspeare, and find—

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* In aid of the funds of the new Association for the Fishermen of Brighton.

> Tongues in trees—books in the running brooks—
> Sermons in stones—and good in every thing.

The beautiful world around us is every where full of objects presenting innumerable varieties of form and structure, of action and position; some of them being inanimate or inorganic, and others possessing organization and vitality. The organic kingdom of nature in like manner was separated into two grand divisions, the animal and the vegetable. The differences between organic and inorganic bodies were very numerous and manifest; but in this brief discourse he need only mention a few obvious and familiar characters. All the parts of an inorganic body enjoyed an independent existence: if he broke off a crystal from the mass before him, the specimen did not lose any of its properties—it was still a mass of crystal as before; but if he removed a branch from a tree, or a limb from an animal, both the one and the other were imperfect, and the parts removed underwent decomposition; the plant withered, the animal matter underwent putrefaction. Again, if crystals, which may be considered the most perfect models of inorganic substances, were formed, these crystals will continue of the same size and figure, unless acted upon by some external force of a chemical or mechanical nature: nor has the crystal any power of increasing or diminishing its bulk but by addition or subtraction externally. In organic bodies the characters are totally different: they acquire definite forms and structure which are capable of resisting for a time the ordinary laws that affect inorganic matter, and internally they are in constant change; from the moment of the first existence of a plant or animal, to the period of its dissolution, there is no repose, youth follows infancy, maturity precedes age. It is thus with the moss and the oak, the mite and the elephant, life and death are common to them all. The lecturer went on to describe the principles of vitality which existed in animals and vegetables, and by which their systems of vessels were enabled to attract and select nutriment, and maintain their existence till the period when the vital principle quitted the frame it had animated. Thus the body became subject to the laws which affect inorganic matter, the bough hangs down, and the slender stem bends towards the earth, the animal falls to the ground, the skin becomes distended, and the graceful form of life disappears, chemical changes begin to operate, decomposition takes place, and finally dust returns to dust and the spirit of man to Him who gave it. Dr. M. next described the essential characters of animal existence and contrasted it with that of the vegetable kingdom; defining the former as possessing certain determinate external forms, which were gradually developed, and having an internal organization possessing systems of vessels for effecting nutrition and support, combined with a nervous system communicating sensation and voluntary motion. The external forms are as various as the imagination can conceive, from the god-like image of man to the shapeless mass of living jelly that floats on the waves; from the elephant and whale to the insect and monad, of which five hundred millions are contained in a single drop of water: in short, so various and dissimilar are the forms of animals even on our own globe, that the opinion of astronomers that the inhabitants of the glorious orbs around us must of necessity, from the different description and conditions of the respective planets, be totally unlike any that exist on the earth, can no longer appear marvellous and incredible. The lecturer then observed, that of all the extraordinary forms, none were more unlike what the common observer would conceive of animals, than the sponges, corals, &c., which were known by the name of zoophytes, from two Greek words signifying animal plants. In this very town Mr. Ellis, in 1752, first discovered the animal nature of sponges, and many other forms previously supposed to be plants. Dr. Mantell then described the *flustra* which occurs on the rocks, and on almost every leaf of sea weed, appearing like a fine lace work. When viewed through a powerful microscope, every pore in this lace work is found to be the cell of a polypus or living animal, in form of a tube with the border fringed with bony feelers or tentacula. These were the instruments by which the animal obtained its prey, it might be seen expanding these feelers, then suddenly contracting them, and retreating into the cell, and then again protruding forth, the whole surface of the flustra exhibiting at every pore a living form. Dr. M. then pointed out on his beautiful drawings magnified views of these extraordinary beings, drawn from living specimens from the sea shore. The *flustra* (which the lecturer observed he took as the type of zoophytal animation, because it was so common,) is a compound animal, consisting of a fleshy substance with an internal calcareous skeleton, the foci of vitality consisting of polypi, by whose agency the life of the whole mass is maintained. How far each polype may possess sensation apart from the rest or from the general mass, whether they are separate centres of sensation, and susceptible of pain and pleasure individually, it is impossible for us to determine. We have a living proof, in our own species, in the Siamese twins, that there may be a united organization with distinct nervous system and individual sensation. However this may be, it is certain that the Almighty Creator of the universe has bestowed on these, as on all his creatures, the capacity and means of enjoyment. Dr. M. then mentioned the various and almost endless forms which this class of animals assumed, some being branched like trees, and flexible, others of a stony hardness; some in large blocks with convolutions on the surface, of which the brain coral was a familiar example; others not unlike large fungi, some of a beautiful blue color; while a well known species was of so exquisite a vermilion, that a comparison with it was the greatest compliment paid to the lips of beauty. This species, the Corallium rubrum, so much used for ornamental purposes, is common in the Mediterranean and other warm seas; and immense quantities are annually obtained for the manufactories at Naples, Leghorn, and other places. In a living state it forms a branched figure of about one foot in height, and is covered over with a fleshy substance of a pale bluish color, is studded with numerous starlike projections, from which issue polypi with six or eight feelers, the whole looking, when the animals are expanded, like a branch of a tree with a crimson base, a bluish bark and numerous flowers. The paintings exhibited by Dr. Mantell, of the red coral when alive, were very beautiful, and admirably illustrative of his description.

All the principal forms of corals were exemplified by drawings, and by a fine and numerous series of specimens, (of the *skeletons*, as the lecturer termed them,) of madrepores, astreæ, &c.

The appearance of the recent zoophytes when seen in tranquil water was described by Dr. M. as most beautiful; the bottom of the Red Sea was so enamelled with them in some parts as to appear like a bed of tulips or dahlias; and when we looked at the drawings of some of the large fungi, which had a crimson disk with a purple and yellow centre, we could not doubt the propriety of the comparison. From the wonderful structure of the zoophytes, Dr. M. proceeded to the consideration of the still more marvellous effects produced by such apparently helpless beings, the production of coral reefs, and finally of islands and even continents. A painting of a circular island produced by these animalculæ was exhibited, Dr. M. describing it from the graphic account of Capt. Flinders, and shewing how it first appeared above the waters, then gradually acquired a covering of soil in which a few plants took root; sea fowl frequented it and brought seeds of other vegetables; these grew, and cocoa nuts wafted thither by the currents, took root, and palms shed their beautiful foliage over the new isle; lastly, man discovered it, erected his hut upon it, and called himself lord of this new creation. Surely, said Dr. Mantell, it is to an insular paradise of this kind that our inimitable poet Moore alludes in those exquisite lines—

> Oh! had we some bright little isle of our own,
> In a blue summer ocean far off and alone,
> Where a leaf never dies in the still-blooming bowers,
> And the bee banquets on through a whole year of flowers, &c.

The lecturer then proceeded to the consideration of the fossil corals, which are found in various parts of England, illustrating his remarks with descriptions and the exhibition of specimens; and lastly, described the extraordinary animal called Encrinite, which is not a coral, but allied to the star fish, and has a long articulated column, on the top of which is a cup-shaped receptacle furnished with numerous tentacula or feelers on the margin; this contained the body of the animal, the mouth being in the centre, and the feelers serving and conveying the prey into it, as in the polypi of the zoophytes. The animal when spread out resembled a flower, and when closed, was very like a lily with the petals partially shut. The skeleton, which was alone found in a fossil state, consisted of an immense number of bones: upwards of thirty thousand had been counted in one individual. The Derbyshire limestone is entirely made up of the petrified bones of these animals, and owes its beautiful markings to the sections of their remains. We have seen, says Dr. Mantell, the marvellous organization of being so minute as to be invisible to the naked eye, their modes of life and action, and the important physical changes effected by such apparently inadequate agents. What beautiful, what striking proofs of the wisdom and goodness of the Eternal are here exhibited. Beings are called into existence, so minute as to elude our unassisted vision, yet possessing powers of voluntary motion and sensation, each with its system of muscles and vessels, and living upon beings still more minute, of which millions might be contained in a drop of water; nay, even that these last are supported by living atoms still less, and so on, and on, till the mind is lost in wonder, and can pursue the subject no farther. Next we see the results produced by these myriads of animated forms; the excess of calcareous matter brought into the waters of the ocean consolidated by the influence of these minute beings, and forming new islands and continents. Lastly, we find in the ancient natural records of our globe, evidence that the Almighty Creator acted by the same agents in past ages. The beds of fossil coral are now the sites of towns and cities, occupied by a people in the highest state of civilization who construct their abodes of the limestone, and ornament their palaces with the marble formed of the consolidated skeletons of the zoophytes which lived and died in an ocean that has long since passed away. Hence we perceive that He who formed the universe creates nothing in vain; his works all harmonize to blessings unbounded by the mightiest or most minute of his creatures; and the more our knowledge is increased, and our powers of observation enlarged, the more exalted are our conceptions of the wonders of creation. Thus, to use the eloquent language of an eminent divine, while the telescope enables us to see a system in every star, the microscope unfolds to us a world in every atom. The one teaches us that this mighty globe, with the whole burden of its people and its countries, is but a grain of sand in the field of immensity—the other, that every atom may harbor the tribes and families of a busy population. The one shews us the insignificance of the world we inhabit, the other redeems it from all its insignificance, for it tells us that in the leaves of every forest, in the flowers of every garden, and in the waters of every rivulet there are worlds teeming with life, and numerous as are the stars of the firmament; the one suggests to us, that beyond and above all that is visible to man, there may be regions of creation which sweep innumerably along, and carry the impress of the Almighty's hand to the remotest scenes of the universe; the other, that within and beneath all that minuteness which the aided eye of man has been able to explore, there may be a world of invisible beings, and that could we draw aside the mysterious curtain which shrouds it from our senses, we might behold a theatre of as many wonders as astronomy can unfold; a universe within the compass of a point so small as to elude all the powers of the microscope, but where the Almighty ruler of all things finds room for the exercise of his attributes, where he can raise another mechanism of worlds, and fill and animate them all with the evidence of his glory.

Art. XVII.—*Influence of the Great Lakes on our Autumnal Sunsets*; by Willis Gaylord.

Foreign tourists speak with rapture of the beautiful dyes imprinted by autumn on the foliage of our American forests; our leaves do not fade and fall, all of the same decaying russet hue, but the rich golden yellow of the linden, the bright red of the soft maple, the deep crimson of the sugar maple, the pale yellow of the elm, the brown of the beach, and the dark green of the towering evergreens, are all blended into one splendid picture of a thousand light shades and shadows. To the observer, our autumnal woodlands are gigantic parterres, the flowers and colors arranged in the happiest manner for softened beauty, and delightful effect. And when these myriads of tinted leaves have fallen to the earth; when the squirrel barks from the leafless branches or rustles among them for the ripened but still clinging brown nuts; the rural wanderer is tempted to throw himself on the beds of leaves accumulated by the wind, and while he looks through the smoke-tinted atmosphere, half imagines that he is gazing on an ocean of flowers.

But the claims of our American autumn upon our admiration, are very far from depending entirely on the rainbow-colored foliage of our woodlands, unrivalled in beauty, though they certainly are: to these must be added the splendors of an autumn sunset, the richness of which, as we are assured, has no parallel in the much lauded sunsets of the rose-colored Italian skies. In no part of the United States is this rich garniture of the heavens displayed in so striking a manner as in the valley of the great lakes, and the country immediately east or southeast of them, and this for reasons which will shortly be assigned. The most beautiful of these celestial phenomena begin to appear about the first of September, sometimes rather earlier, and with some exceptions last through the months of September and October, unless interrupted by the atmospheric changes consequent on our equinoctial storms, and gradually fade away in November with the Indian summer, and the southern declination of the sun. Not every cloudless sunset during this time, even in the most favored sections, is graced with these splendors; there seems to be a peculiar state of the atmosphere necessary to exhibit these beautiful reflections, which however often witnessed, must excite the admiration of all who view them, and are prepared to appreciate their surprising richness.

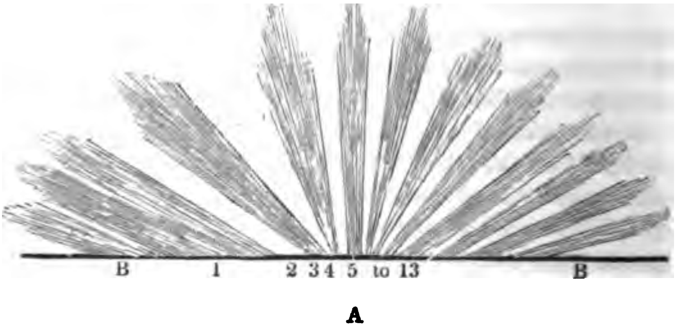
On the most favored evenings the sky will be without a cloud; the temperature of the air pleasant; not a breeze to ruffle a feather, and a dim transparent haze tinged of a slight carmine by the sun's light, diffused through the whole atmosphere. At such a time, for some minutes both before and after the sun goes below the horizon, the rich hues of gold, and crimson, and scarlet, that seem to float upward from the horizon to the zenith, are beyond the power of language to describe. As the sun continues to sink, the streams of brilliance gradually blend and deepen in one mass of golden light, and the splendid reflections remain long after the light of an ordinary sunset would have disappeared. We have said that not every cloudless sunset exhibits this peculiar brilliance; when the air is very clear, the sun goes down in a yellow light it is true, but it is comparatively pale and limited; and when as is sometimes the case in our Indian summers, the atmosphere is filled with the smoky vapor rising from a thousand burning prairies in the far west, he sinks like an immense red ball without a single splendid emanating ray. It is our opinion that the peculiar state of the atmosphere necessary to produce these gorgeous sunsets in perfection, is in some way depending on electrical causes; since it very commonly happens, that after the brilliant reflections of the setting sun have disappeared, the auroral lights make their appearance in the north, and usually the more vivid the reflection, the more beautiful and distinct the aurora. This fact the numerous and splendid northern lights of last September, succeeding sunsets of unrivalled beauty, must have rendered apparent to every observer of these atmospheric changes. Connected however with this state of the atmosphere, and cooperating with it, is another cause we think not less peculiar and efficient, and which we do not remember ever to have seen noticed in this connection, and that is the influence of the great lakes acting as reflecting surfaces.

Every one is acquainted with the fact that when rays of light impinge or fall on a reflecting surface, as a common mirror, they slide off so to speak, in a corresponding angle of elevation or depression, whatever it may be. The great American lakes may in this respect be considered as vast mirrors, spread horizontally upon the earth, and reflecting the rays of the sun that fall upon them, according to the optical laws that govern this phenomenon. The higher the sun is above the horizon the less distance the reflected rays would have to pass through the atmosphere, and of course the less would be the effect produced by them; while at and near the time of setting, the rays striking horizontally on the water, the direction of the reflected rays must of course be so also, and therefore pass over or through the greatest possible amount of atmosphere previous to their final dispersion. It follows that objects on the earth's surface, if near the reflecting body, require but little elevation, to impress their irregularities on the reflected light; and hence any considerable eminences on the eastern shore of the great lakes, would produce the effect of lessening, or totally intercepting these rays at the moment the sun was in a position nearly or quite horizontal. The reflecting power of a surface of earth, though far from inconsiderable, is much less than that of water, and may in part account not only for the breaks in the line of radiance which exist in the west, but for the fact that the autumnal sunsets of the south are inferior in brilliance to those of the north. We have been led to this train of thought at this time, by a succession of most beautiful sunsets, which, commencing the last week in August, have continued through the months of September and October, with a few exceptions, in consequence of the atmospheric derangement attending the usual equinoctial gales.

It will be seen by a reference to a map of the United States, that from the residence of the writer, (Otisco, Onondaga Co. N. Y.,) the lakes extend on a great circle from north to south of west, and of course embrace nearly the whole extent of the sun's declination, as observed from this place. The atmosphere of the north then with the exception of a few months is open to the influence of reflected light from the lakes, and we are convinced that most of the resplendent richness of our autumnal sunsets may be traced to this source. The successive flashes of golden and scarlet light that seem to rise and blend and deepen in the west, as the sun approaches the horizon and sinks below it, can in no other way be so satisfactorily accounted for as by the supposition, that each lake, one after the other, lends its reflected light to the visible portion of the atmosphere, and thus as one fades, another flings its mass of radiance across the heavens, and acting on a medium prepared for its reception, prolongs the splendid phenomena.

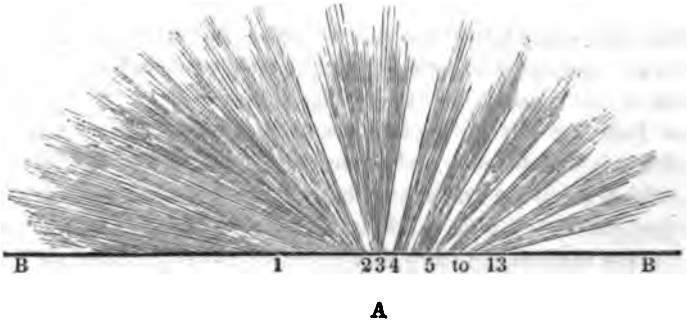
We have for years noticed these appearances and marked the fact, that in the early part of September, the sunsets are generally of unusual brilliancy, and more prolonged than at other or later periods. They are at this season, as they are at all others, accompanied by pencils or streamers of the richest light, which diverging from the position of the sun, appear above the horizon, and are sometimes so well defined that they can be distinctly traced nearly to the zenith. At other seasons of the year, clouds just below the horizon at sunset produce a somewhat similar result in the formation of brushes of light; and elevated ranges of mountains, by intercepting and dividing the rays, whether direct or reflected, effect the same appearances; but in this case there are no elevated mountains, and on the most splendid of these evenings the sky is always perfectly cloudless. We have marked the uniformity in the relative position of these pencils at the same season of the year for a great number of years; and this uniformity, while it proves the permanence of their cause, has led us to trace their origin to the peculiar configuration of the country bordering on the great lakes.

At the time of year these pencils are beginning to be the most distinct, a line drawn from this point to the sun would bear at sunset, about twenty five degrees north of west, passing over the west end of lake Ontario, the greatest diameter of Lake Huron, and across a considerable portion of Lake Superior. At this time, or about the first of September, the streamers or pencils exhibit somewhat the appearance shown in the following engraving:

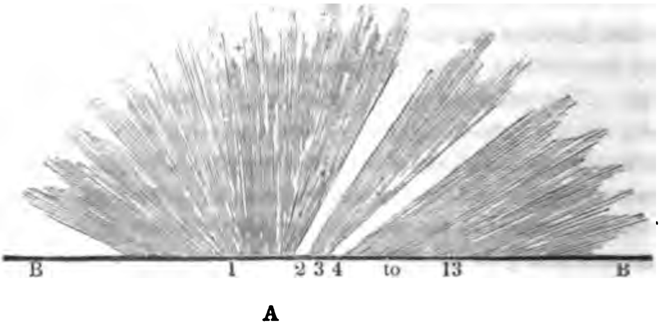


Here A, represents the place of the sun, some two or three degrees below the horizon B, B. Fig. 1, denotes the reflections from Lake Erie. 2, the comparatively dark space caused by the peninsula between Lake Erie and Lake St. Clair. 3, represents the reflected rays from St. Clair. 4, the now reflecting peninsula between the St. Clair and Lake Huron; and 5 to 13 the reflection from Lake Huron, broken into pencils by the elevated lands on the south-eastern margin of the lake.

relative position of the sun and the lakes, the nature of reflecting surfaces, and the hills that it has been ascertained border Lake Huron on the east, it appears clear to us, that the broken line of these hills acts the part of clouds or mountains in other circumstances, in intercepting and dividing into pencils the broad mass of light reflected from the Huron, and thus creating those beautiful streamers that appear in the north of west, and with which, as it were, the commencement of autumn and the Indian summer is marked. Farther to the south, appears distinctly the break occasioned by the land that intervenes between the Lakes Huron and St. Clair, and this as well as the one between the latter lake and Erie, is rendered more striking by the brilliant pencil streaming across the heavens from the St. Clair. The reflected light of this body of water, insulated as it is by the shaded spaces in the sky, and separated from the glowing masses to the north and the south, is, throughout the season, one of the most striking and best defined objects in the west. From the middle of September to the early part of October, during which time the sun sets nearly in the west from this place, the appearance of the reflected rays is somewhat like the representation below.



Here the letters and figures represent the same objects as in the former cut, and show that the cause of the pencils must be permanent or such a change in their inclination would not take place with the declination of the sun. The reflections from Erie at this time rise in a broad unbroken mass a little south of west, while that from St. Clair occupies the centre, and the maze of pencils from Huron begin to blend and show nearly as one body. As the sun returns still farther south, the light from Erie occupies a still more prominent place; the column of light from the St. Clair inclines still more to the right; the breaks from the isthmuses of Erie and Huron become less distinct; the reflections from the Huron are melted into an unbroken mass, the interruption from the hills being lost in the oblique position of the pencils; and the sun has scarcely time to leave this extensive line of reflection, before all these streamers and breaks are abruptly melted into the rich dark crimson that floats up from the Michigan, or the mighty Superior. At the close of October or the first of November, the splendor of the heavens, though sensibly diminished, is at times very great, and the outline of the reflections presents the following appearance.



The figures and letters are still the same, and taken in connection with the southern declination of the sun shows as before the fixed nature of the causes, and their relative position to the observer. Lake Erie now fills up the foreground in the direction of the sun; St. Clair is still distinct, and separated from Erie and Huron; the hills which in early autumn were between us and the sun, and broke up the light thrown from the Huron into such beautiful pencils, are now to the northward of any light reflected to us, if indeed they are not beyond the line of rays from the lake, and the streamers from this source disappear from the heavens, not to return, until, with another year and a renewed atmosphere, the sun is again found in the same position. Were there any elevated ranges on the peninsula of Michigan, we might reasonably expect that the reflected light from that body of water, would be broken as is the cone from Lake Huron. But Michigan is too level to offer in its outline any such interruption, hence the pencils must fade away with the disappearance of the sun from the line of the Huron, St. Clair, and Erie. It is possible too that as the season advances the atmosphere loses its proper reflecting condition, and renders it impossible for reflected change denoted by the fact that in the region of the lakes, thunder rarely occurs after these phenomena become visible, and that these are usually accompanied or followed by the aurora, would seem to render such a supposition probable.

We have thrown out these hints—for we consider them nothing more—in the hope of directing the notice of other and more competent observers to the facts stated, and, if possible, thereby gaining a satisfactory solution of the splendid phenomena connected with our autumnal sunsets, (should the foregoing not be considered as such,) or should further observations show that any of the above premises or inferences have been founded in error.

Otisco, November 8, 1837.

Art. XVIII.—*Some Remarks on the Genus Paradoxides of Brongniart, and on the necessity of preserving the Genus Triarthrus, proposed in the Monograph of the Trilobites of North America;* by Jacob Green, M. D., Professor of Chemistry in Jefferson Medical College.

The genus Paradoxides, first proposed by Prof. Brongniart, and founded on a magnificent trilobite in M. DeFrance's collection, has embarrassed most fossil zoologists who have attempted to make use of it in arranging and describing their specimens. The late Professor Dalman, in his important memoir on the trilobites, published in the Transactions of the Swedish Academy, would not admit the genus as it now stands, into his work, but grouped some of the species included in it, under the generic name of *Olenus*.

The animal remain in M. DeFrance's cabinet, is called by Prof. Brongniart *Paradoxides spinulosus*, and was the only Paradoxides which he had examined when his valuable work on the Trilobites first appeared. Dr. Wahlenberg's fine figure of the old Linnean *Entomolithus paradoxus*, was so analogous in all its principal characters to the fossil of DeFrance, that he not only did not hesitate to consider it another species of the same genus, but he gave the generic name itself to this group, to preserve the memory of Linne's singular relic. Now if this genus had embraced those animals only, which exhibit, what its author considers, its *essential* characters, there would have been no difficulty on this subject. These characters are, that the animals should be ***blind***, and that the arches of the lobes, and *especially* those of the *tail*, should be ***prolonged beyond*** the membrane which sustains them. But notwithstanding these remarks, and doubtless from a desire not to multiply names, Professor Brongniart has introduced into his genus Paradoxides, from *drawings*, three animals, which bear a very faint resemblance to those on which it was founded; these fossils he names P. scaraboides, P. gibbosus, and P. laciniatus. The first has an expanded tail, somewhat like an *Asaph;* the second has *no prolongation* whatever of the lateral and caudal arches, and the third is supposed to be furnished with *eyes*. I have but little doubt that Prof. Brongniart will exclude these fossils when he comes to examine them for himself from his otherwise natural genus Paradoxides, in some future edition of his most admirable work.

The practice adopted by some of amending, modifying, or in some essential point, altering the generic characters of one author to adapt them to new animals discovered by another, I suppose to be altogether inadmissible and contrary to the established canons of a correct nomenclature.

I have been led to these remarks in consequence of some recent attempts to force my genus Triarthrus into that of Paradoxides. It is not pretended, I believe, that the animal remain I have described as *Triarthrus Beckii*, bears the most distant resemblance to the *P. spinulosus* or the *P. tessini*, the only true Paradoxides of Brongniart, but that the *head*, according to one author, is like that of the P. scaraboides, and the tail, according to another, is similar to that of the P. gibbosus. It is obvious that by such a process of compression and amalgamation, of decapitation and curtailment, all generic distinctions would be of little value.

It is one of the fixed principles of nomenclature among naturalists, that the first name applied to a genus, should be invariably retained, and that the author himself of the genus should not be allowed, without the most cogent reasons, to infringe this law. From the great accumulation of species, and from the new discoveries with regard to old ones, in fossil zoology, it is plain that if we adhere to the genera as first established, and create no others; or if, on the plan of Fabricius, we make subdivisions of them, by introducing new characters to adapt them to new objects, then the genera will not only be overloaded, so as to be comparatively useless, but they will necessarily embrace animals very imperfectly characterized. Again, it is maintained by many, that an indispensable condition to the establishment of a genus, is that some species be at the same time exhibited as typical of the whole group. When this can be done, its expediency and propriety is exceedingly obvious; but when we consider our imperfect views of organized beings, taken as a whole,—and more especially our limited knowledge of fossilized bodies, a knowledge, however, which is almost daily increasing; it is manifest that species now at the head of a genus, will, in the progress of discovery, more naturally arrange themselves in some other position in the group. But when an author himself regards a particular species as the type of his genus, we must, I suppose, retain his generic name for that type, whatever may become of the other species which our imperfect knowledge may have led us afterwards to group with it.

Governed by the preceding principles, I would suggest the propriety of limiting the genus Paradoxides of Brongniart to those fossil remains only, which are allied in their structure to the P. tessini and P. spinulosus, and which must be regarded a typical species. On the same ground I would urge the necessity of retaining the genus Triarthrus, which was proposed in 1832. A slight comparison of some of the essential characters of the two genera, will prove the importance of separating them.

PARADOXIDES.	TRIARTHRUS.
Body—depressed—not contractile.	*Body*—elevated—contractile.
Costal arches—with filamentous or spinous prolongations.	*Costal arches*—with no prolongations whatever.
Lateral lobes—wider than the middle lobe.	*Lateral lobes*—not wider than the middle lobe.

For these reasons, and some others which might be specified, I conceive that the genus Triarthrus ought not to be merged in that of Paradoxides.

The following may be considered as the generic characters of the Triarthrus.

Body slightly convex—contractile.

Buckler—with transverse furrows or folds.

Oculiferous tubercles—none.

Abdomen, with ten or more articulations.

Lateral lobes, not prolonged as in Paradoxides.

Tail simple, or furnished with a membranaceous expansion.

The peculiar organization of the tail naturally divides the genus into two sections, and all the species, as far as they are known, may be arranged as follows.

GENUS TRIARTHRUS.

Tail simple, or without membranaceous expansion..

T. Beckii.
T. Gibbosus. (P. Gibbosus of Bróng.)

Tail with membranaceous expansion.

T. Scaraboides. (P. Scaraboides, Brong.)
T. Laciniatus? (P. Laciniatus, Brong.)

In the last number of your Journal there is a very interesting paper on some trilobites, by James Hall, Esq., and he has had the good fortune to discover and describe the first perfect specimen of our Triarthrus Beckii, the only American species of this genus which I suppose has yet been found. His excellent paper contains the figure and description of what he imagines to be another species, but judging from the representation he has given of it, and from the numerous *heads* or *bucklers* of the animal in my possession, the curvature of the external margin of the cheeks, which seems to constitute the principal peculiarity, has been produced by the manner in which the animal has been fossilized.

Before closing these remarks, I may mention an objection which has been urged against the genus Triarthrus, because it was founded on the supposition that the *buckler* was the abdomen of the animal. This objection, I think, will not be considered valid, especially as the term Triarthrus, which, though originally applied to the three divisions or articulations, of what was then supposed to be the abdomen, may now, without much latitude of interpretation, be considered as referring to the three lobes, or longitudinal divisions of the body, the name would then be analogous to *Trilobite*, *Trimerus*, and other appellations common in zoological nomenclature. At any rate, I now propose the name Triarthrus, for the group as above characterized.

Art. XIX.—*Remarks on the Barometer, with a table of Meteorological Observations, made on board of the U. S. Ship Peacock, from July 8th, to August 17th,* 1837, *during a passage from Peru to the United States, by way of Cape Horn, reported by* W. S. W. Ruschenberger, M. D., Surgeon U. S. Navy, &c.

The barometer has not been in general use in the Navy of the United States more than fifteen or twenty years. Though this period is sufficient for establishing its utility in foretelling states of weather, it has not yet gained the universal confidence of the officers. However certain the indications of this instrument may be on shore, where it is at perfect rest, and where the observations may be made with the nicest accuracy, the same cannot be said of it when at sea; where, from the incessant motion of the ship, in spite of the best mechanical contrivance for its suspension, the mercurial column is constantly fluctuating, and therefore the observations are obnoxious to error, and at best must be considered only as proximative to the truth.

In the British navy the same difference of opinion prevails, though we might infer, that it is implicitly relied on in some instances. We were told, when in China, that the commander of an English two-and-thirty gun frigate, in the month of August, 1835, actually threw overboard all his guns, because the rapid sinking of the barometer indicated an approaching typhoon. This gentleman took to himself the credit of thereby saving the ship, which was in a few hours afterwards thrown upon her beam ends by a violent storm, and with difficulty saved from total loss, even thus lightened of her battery. Such instances must go far in establishing the claims of the instrument to confidence.

It is pretty generally conceded that the barometer is more faithful in its indications in some positions than in others; and while it is almost altogether distrusted near the equator, it is confidently referred to in high latitudes. In the city of Lima, Lat. 12° S, Dr. Unànue, (Observaciones sobre el clima de Lima,) tells us, the barometer only varies from two to four lines throughout the year, without any established order, the range being two lines higher in the summer than in the winter. It should be borne in mind, that the atmosphere of this region is rarely affected by any very strong commotion; and in one instance, (April, 1808,) just before a fresh south gale, it rose between two and three lines above its ordinary maximum height. In the island of Ceylon, also near the equator, the barometer invariably foretells an approaching gale.

At places beyond the tropics, scarcely a difference of opinion exists on the subject. At Valparaiso, Lat. 33° S., any considerable fall of the mercury is almost always followed by a gale from the north, accompanied by heavy rain; and at the Cape of Good Hope, Lat. 35° S., the sinking of the barometer always precedes the storm. Off Cape Horn, Captain King, R. N., found its indications of the utmost value, and states that its variations "correspond to those of high northern latitudes in a remarkable manner, changing south for north, east and west remaining the same." In another place he says, "with respect to the utility of the barometer as an indicator of the weather that is experienced off Cape Horn, I do not think it can be considered so unfailing a guide as it is in the lower or middle latitudes. Captain Fitz Roy, however, has a better opinion of the indications shown by this valuable instrument: my opinion is, that although the rise or fall precedes the change, yet it more frequently accompanies it."*

The barometer is subject to a diurnal flux and reflux, which was first remarked, I believe, by Baron Humboldt, in 1802, at Lima, and since confirmed by various observers at other places. At that place, Dr. Unànue states, it rises from five o'clock, A. M. until nine, the time of its maximum height; from that hour until meridian, it remains stationary; then falls until four o'clock, P. M. and remains stationary; it again rises from seven till eleven o'clock, and again descends from midnight until four o'clock, A. M.

The variations of the barometer were noted every four hours, through the day and night, in a range of 93 degrees of latitude in the Atlantic, and 45 degrees in the Pacific ocean.

The first column in the table shows the day upon which the observations were made; the second, the position of the ship; the third, the hour of the day, beginning at the meridian, (marked m,) the figures 4 and 8, immediately following, are four and eight o'clock, P. M.; 0, is the sign of midnight, and the figures 4 and 8 are four and eight o'clock, A. M.; so that the divisions of the day are in accordance with the nautical method of reckoning time. The fourth column contains the variations of the barometer; the fifth and sixth, the temperature of the air and water by Fahrenheit's thermometer; the seventh, the direction of the wind; the eighth, the distance run by log each four hours, to show proximately the force of the wind, reefs, the ship was under full sail.

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* Sailing Directions for the coasts of eastern and western Patagonia, &c., by Philip Parker King, Captain R. N., F. R. S., &c. London: 1832.

The temperature of the air and water were examined by the same thermometer, and therefore we may suppose the temperature of the air is marked lower than it actually was, as the mercury would fall something from the evaporation of the moisture left upon the glass after each immersion.

According to the table, the fluctuations of the barometer do not precede the changes of weather, but as Captain Fitzroy remarks, seem to accompany them. On the 28th of July, the ship was lying-to in a gale, the barometer standing at 29.76 inches; on the 29th, the barometer standing at 30.15, the ship is still lying-to, the weather moderating with the rise of the mercury. The barometer having fallen in the preceding five days from 30.50 to 29.75, on the 4th August, (lower than it was in the gale of the 28th July,) the weather was cloudy and the wind moderate. The mercury continued to fall until the 11th, when it stood at 28.40, yet in the mean time the weather, though somewhat boisterous, was not so heavy as to require the ship to lie-to. The same description of weather was experienced under almost all the variations of the barometer, though it was commonly fair when the mercury stood above thirty inches, but not invariably so.

The observations do not show that the mercury has a regular diurnal flux and reflux, though it was seldom stationary throughout the twenty-four hours.

It would seem, from our present knowledge, that the fluctuations of the barometer indicate changes of weather differently in different latitudes; while a rise of the mercury in some regions is followed by fresh gales, in others, the same phenomena follow the fall of the column. If this be established, it is clear that the barometer is not of universal practical use in navigation, but requires to be studied for particular regions.

Though we may generalize from the table before us, the observations are too limited to infer any general rules, or establish any one fact in relation to the practical use of the instrument; but, sufficient evidence, with very little labor, might very soon be accumulated by navigators, to put all questions at rest in regard to it.

The temperature of the water, both in the Pacific and Atlantic, was constantly higher than that of the air, and increased as we approached the land at Rio de Janeiro, as well as at Bahia.

U. S. Ship Peacock, Norfolk, Va., October 27, 1837.

*Meteorological Observations, made on board of the U. States Ship Peacock, on her passage from Huacho, (Peru,) to the United States, viâ Cape Horn,** 1837.

Date.	Position.	Hour.	Barometer.	Air.	Water.	Winds.	Distance.	Weather.
July 8	Lat.	m.	29.95	66		Sd. Ed.		Pleasant.
	12°18′ s.	4	29.96			"		"
		8	29.99	68		"	10	"
	Lon.	0	30.00	67	70	"	25	"
	78° 59′	4	29.98	66	70	"	24	"
		8	29.98	66	70	"	30	"
" 9	Lat.	m.	29.98	67	69	Sd. Ed.	23	"
	14°14′ s.	4	29.93	66	68	"	25	"
		8	29.96	65	68	"	30	Cloudy.
	Lon.	0	29.95	65	67	"	27	Cloudy, reefs.
	80°58′ w.	4	29.94	64	66	"	23	Squally.
		8	30.00	65	68	"	25	Cloudy.
" 10	Lat.	m.	30.00	65	69	"	31	"
	16° 18′	4	30.65	66	68	"	28	Cloudy and squally.
		8	30.00	66	68	"	31	"
	Lon.	0	30.00	66	70	"	29	Cloudy.
	82° 46′	4	29.98	66	68	"	28	"
		8	30.03	65	68	"	24	"
" 11	Lat.	m.	30.03	67	68	"	24	"
	17°25′ s.	4	30.00	66	69	"	14	"
		8	30.03	66	68	"	14	"
	Lon.	0	30.00	66	68	"	17	"
	84° 10′	4	30.05	65	68	"	18	Flawy.
		8	30.05	66	69	"	16	Pleasant.
" 12	Lat.	m.	30.08	68	70	"	10	"
	17° 31′ s.	4	30.03	70	71	"	6	"
		8	30.05	67	69	"	5	"
	Lon.	0	30.05	67	69	Calm.	5	"
	84° 29′	4	30.05	68	69	Sd. Ed.	3	"
		8	30.05	68	70	Calm.	0	"
" 13	Lat.	m.	30.09	70	70	Variable	3	"
	18°3′ s.	4	30.00	69	70	"	10	Squally.
		8	30.02	67	69	Sd. Ed.	22	Squally, reefs.
	Lon.	0	30.00	69	70	"	18	Cloudy.
	85° 42′	4	30.00	67	69	"	16	"
		8	30.05	68	70	"	13	Moderate.

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* The observations after doubling Cape Horn, are, by permission of the author, omitted—as those now published give the most interesting, and the remainder, although valuable, are too extensive for our pages.—Ed.

Date.	Position.	Hour.	Barometer.	Air.	Water.	Winds.	Distance.	Weather.
July 14	Lat.	m.	30.05	67	69	Sd. Ed.	8	Pleasant.
	19° 08′ s.	4	30.00	69	70	"	14	"
		8	30.00	68	70	"	15	"
	Lon.	0	30.00	67	70	"	12	Squall.
	86° 50′	4	29.95	67	70	"	17	Cloudy.
		8	30.00	67	70	"	12	"
" 15	Lat.	m.	30.00	69	70	"	17	Pleasant.
	20° 10′ s.	4	29.98	69	70	"	17	"
		8	30.03	68	70	"	16	"
	Lon.	0	30.05	68	70	"	19	"
	88° 28′	4	30.00	66	70	"	19	"
		8	30.05	68	70	South'd.	22	"
" 16	Lat.	m.	.	68	70	Sd. Ed.	17	"
	21° 11′ s.	4	30.07	69	71	"	17	"
		8	30.07	70	71	"	4	Squally.
	Lon.	0	30.08	69	70	"	5	Pleasant.
	89° 54′	4	30.07	68	70	"	15	Cloudy, rain.
		8	30.09	68	70	"	23	Pleasant.
" 17	Lat.	m.	30.10	69	70	"	19	"
	22° 58′ s.	4	30.08	68	70	"	23	"
		8	30.07	68	70	"	25	Cloudy.
	Lon.	0	30.13	67	70	"	21	Squally.
	91° 36′	4	30.13	66	70	"	27	"
		8	30.15	67	71	"	27	Pleasant.
" 18	Lat.	m.	30.15	67	71	S. E.	30	"
	24° 34′ s.	4	30.15	68	69	"	29	"
		8	30.20	68	70	"	27	"
	Lon.	0	30.18	69	71	"	20	Squally.
	92° 26′	4	30.15	67	70	"	12	"
		8	30.18	68	70	"	5	Pleasant.
" 19	Lat.	m.	30.18	70	71	"	9	"
	25° 27′ s.	4	30.19	68	70	East'd.	18	"
		8	30.16	68	70	Variable	11	"
	Lon.	0	30.19	68	70	Calm.	2	"
	93° 26′	4	30.15	67	70	Sd. Ed.	6	"
		8	30.15	67	70	"	17	"
" 20	Lat.	m.	30.16	69	70	"	6	"
	26° 01′ s.	4	30.15	70	70	"	6	"
		8	30.17	67	69	"	7	"
	Lon.	0	30.19	67	69	South'd.	10	"
	93° 03′	4	30.18	65	69	"	7	"
		8	.	67	70	"	15	"

Date.	Position.	Hour.	Barometer.	Air.	Water.	Winds.	Distance.	Weather.
July 21	Lat.	m.	30.20	69	70	South'd.	19	Fine weather.
	26° 58′ s.	4	30.17	67	69	S. W.	13	"
		8	30.15	65	69	"	24	Cloudy.
	Lon.	0	30.15	66	68	South.	19	Cloudy, squally, reefs.
	91° 30′	4	30.12	64	69	S. E.	25	Cloudy, fresh.
		8	30.15	67	69	"	23	Cloudy, squall and rain.
" 22	Lat.	m.	30.15	66	69	"	19	Moderate, pleasant.
	28° 26′ s.	4	30.12	65	68	"	16	"
		8	30.17	64	67	"	30	Clouds.
	Lon.	0	30.18	64	67	"	29	Fresh, pleasant.
	93° 45′	4	30.18	62	66	"	14	Pleasant.
		8	30.22	64	67	"	20	"
" 23	Lat.	m.	30.22	64	66	"	22	Fine.
	29° 24′ s.	4	30.18	60	67	"	22	Pleasant.
		8	30.23	62	66	"	21	"
	Lon.	0	30.24	62	65	"	14	"
	94° 39′	4	30.25	62	64	Calm.	4	"
		8	30.24	63	65	Variable	4	Cloudy.
" 24	Lat.	m.	30.24	64	65	Calm.	2	"
	30° 07′ s.	4	30.20	64	66	"	1	Pleasant.
		8	30.26	63	64	"	1	"
	Lon.	0	30.25	60	64	Variable	4	"
	94° 05′	4	30.25	63	64	Nd. Wd.	4	"
		8	30.25	63	64	"	12	"
" 25	Lat.	m.	30.25	65	65	"	5	"
	32° 27′ s.	4	30.25	65	65	"	14	"
		8	30.25	65	65	"	24	"
	Lon.	0	30.25	64	63	"	26	"
	92° 53′	4	30.23	64	63	"	28	"
		8	30.25	62	63	"	30	"
" 26	Lat.	m.	30.25	63	64	"	36	Squally.
	35° 15′ s.	4	30.10	62	61	"	37	Squally, fresh.
		8	30.07	62	60	"	37	Reefs, squally, fresh.
	Lon.	0	30.00	62	59	"	36	Squally, fresh.
	90° 32′	4	29.95	56	58	Sd. Wd.	30	Squally, with rain.
		8	29.97	56	59	"	30	Squally and cloudy.
" 27	Lat.	m.	29.90	55	57	"	28	Fresh and clear.
	35° 41′ s.	4	29.92	55	57	"	18	Hove to.
		8	30.05	53	57	"	4	Fresh and squally.
	Lon.	0	30.10	53	57	South'd.	0	"
	89° 28′	4	30.12	53	56	Calm.	13	Moderated.
		8	30.10	55	56	"	12	"

Date.	Position.	Hour.	Barometer.	Air.	Water.	Winds.	Distance.	Weather.
July 28	Lat.	m.	.	56	57	Calm.	1	Pleasant.
	37° 05′ s.	4	30.05	48	51	Variable	11	“
		8	30.07	48	49	N. W.	25	Rain, reefs.
	Lon.	0	29.76	48	50	S. W.	34	“
	88° 07′	4	29.76	48	49	South'd.	27	Lying to.
		8	29.83	47	49	“	17	“
“ 29	Lat.	m.	30.00	48	50	“	4	Squally.
	37° 08′ s.	4	30.15	47	50	Sd. Ed.	0	“
		8	30.15	44	50	“	6	Lying-to.
	Lon.	0	30.25	46	49	“	6	Moderate.
	88° 41′	4	30.26	44	48	“	5	“
		8	30.33	45	49	Calm.	1	Pleasant.
“ 30	Lat.	m.	30.35	49	50	“	0	“
	38° 39′ s.	4	30.30	49	50	“	0	“
		8	30.36	47	49	Nd. Wd.	7	“
	Lon.	0	.	46	48	“	16	Moderate.
	88° 08′	4	30.38	47	49	Nd. Ed.	21	“
		8	30.40	48	48	“	22	Cloudy.
“ 31	Lat.	m.	30.45	48	49	“	31	“
	42° 18′ s.	4	30.45	47	49	North'd.	33	“
		8	30.50	47	47	“	35	Squalls, rain.
	Lon.	0	30.45	46	45	“	36	“
	86° 25′	4	30.45	46	47	“	36	Cloudy.
		8	30.42	16	46	“	37	Squall, rain.
Aug. 1	Lat.	m.	30.40	47	46	“	40	Fine.
	46° 04′ s.	4	30.40	45	45	“	38	Cloudy.
		8	30.35	44	44	“	36	“
	Lon.	0	30.26	44	43	Nd. Wd.	36	“
	85° 25′	4	30.40	43	43	“	40	“
		8	30.15	42	42	“	40	“
“ 2	Lat.	m.	30.13	43	43	North'd.	40	Hazy.
	49° 39′ s.	4	30.05	42	42	“	38	Cloudy.
		8	30.00	40	40	“	36	“
	Lon.	0	29.98	42	39	“	38	“
	83° 43′	4	29.83	41	39	“	39	“
		8	29.76	40	39	“	39	“
“ 3	Lat.	m.	29.70	40	39	“	36	“
	52° 04′ s.	4	29.62	42	39	Nd. Ed.	38	Rain.
		8	29.54	41	38	Nd. Wd.	37	Reefs.
	Lon.	0	29.55	36	38	Sd. Wd.	29	“
	81° 50′	4	29.70	37	37	“	29	“
		8	29.74	38	37	“	25	“

Date.	Position.	Hour.	Barometer.	Air.	Water.	Winds.	Distance.	Weather.
	Lat.	m.	29.90	36	38	Sd. Wd.	25	Moderate.
	53° 50′ s.	4	29.90	42	41	Nd. Wd.	11	Cloudy.
Aug. 4		8	29.92	44	43	“	8	Reefs.
	Lon.	0	29.85	41	44	“	11	Cloudy.
	80° 09′	4	29.90	42	43	“	21	“
		8	29.75	40	42	Nd. Ed.	25	No reefs.
	Lat.	m.	29.72	41	42	“	32	Cloudy.
	55° 48′ s.	4	29.62	41	41	“	35	Rain, cloudy.
“ 5		8	29.55	44	42	“	38	Rain, reefs.
	Lon.	0	29.38	44	42	“	32	“ “
	76° 13′	4	29.29	43	41	“	26	Rain, no reefs.
		8	29.20	41	40	“	29	“ “
	Lat.	m.	29.15	44	42	“	22	“ “
	56° 26′ s.	4	29.22	41	41	Nd. Wd.	24	Rain, squally.
“ 6		8	29.10	40	40	West’d.	22	“ “
	Lon.	0	29.14	36	39	Sd. Ed.	33	Hail, squally.
	71° 36′	4	29.27	35	40	South’d.	32	Snow, squally.
		8	29.40	34	44	Sd. Wd.	36	“ “
	Lat.	m.	29.43	32	40	“	30	Cloudy, reefs.
	56° 22′ s.	4	29.55	29	38	Sd. Ed.	30	Snow squalls, reefs.
“ 7		8	29.65	31	39	“	27	“ “
	Lon.	0	29.64	34	39	“	28	“ “
	66° 24′	4	29.64	37	42	Sd. Wd.	34	Rain, squalls.
		8	29.62	39	41	“	32	Snow squalls, reefs.
	Lat.	m.	29.70	40	45	“	32	“ “
	54° 43′ s.	4	29.70	36	42	“	32	No reefs, squally.
“ 8		8	29.72	38	40	“	27	Rain and hail.
	Lon.	0	29.76	38	40	“	23	Rain and sleet.
	62° 13′	4	29.80	36	39	“	24	Moderated.
		8	29.75	35	42	Nd. Wd.	27	Pleasant.
	Lat.	m.	29.83	39	43	“	28	Squally, reefs.
	54° 41′ s.	4	29.70	38	40	“	33	“ “
“ 9		8	29.72	38	39	“	29	“ “
	Lon.	0	29.55	38	40	“	19	Squally, hail.
	59° 06′	4	29.38	36	40	“	0	Lying to.
		8	29.15	38	40	“	0	“
	Lat.	m.	29.05	42	42	Nd. Ed.	8	Moderating.
	54° 01′ s.	4	29.00	41	40	Nd. Wd.	13	“
“ 10		8	29.00	40	40	“	16	Clear.
	Lon.	0	28.95	41	40	“	18	“
	57° 11′	4	28.75	40	39	“	17	Rainy.
		8	28.52	41	41	Nd. Ed.	12	“

Date.	Position.	Hour.	Barometer.	Air.	Water.	Winds.	Distance.	Weather.
Aug. 11	Lat.	m.	28.45	41	40	Nd. Wd.	14	Fog.
	51° 34′ s.	4	28.40	39	40	Sd. Wd.	20	Cloudy.
		8	28.45	39	39	“	37	Reefs, cloudy, rain.
	Lon.	0	28.40	39	39	“	38	Reefs, rain.
	53° 43′	4	28.55	39	40	“	43	Cloudy.
		8	28.73	40	39	“	40	“
“ 12	Lat.	m.	28.70	42	39	“	33	“
	48° 51′	4	28.91	40	39	“	35	Moderate.
		8	29.07	40	39	“	37	Clear.
	Lon.	0	29.07	40	39	“	36	“
	51° 07′	4	29.05	39	38	“	33	“
		8	29.00	40	39	Nd. Wd.	25	“
“ 13	Lat.	m.	29.09	42	41	“	28	Squally, reefs.
	46° 34′ s.	4	28.80	46	46	Variable	8	Nearly calm.
		8	28.90	41	42	South'd.	16	Rain, cloudy.
	Lon.	0	29.04	40	42	Sd. Wd.	30	Pleasant.
	48° 55′	4	29.22	40	40	“	39	“
		8	29.32	40	39	“	40	“
“ 14	Lat.	m.	29.30	40	42	“	40	Moderate.
	43° 43′ s.	4	29.44	46	47	“	34	“
		8	29.50	46	48	“	30	Squally, rain.
	Lon.	0	29.62	46	47	“	29	Moderate.
	47° 01′	4	29.69	46	46	“	29	Moderate, clear.
		8	29.75	47	47	“	33	“ “
“ 15	Lat.	m.	29.80	48	48	“	36	“ “
	41° 20′ s.	4	29.90	48	46	“	32	Fine weather.
		8	29.90	48	48	“	27	“
	Lon.	0	29.91	49	50	“	26	“
	45° 09′	4	29.90	49	50	“	30	“
		8	29.96	49	50	“	29	“
“ 16	Lat.	m.	29.95	52	54	“	28	“
	39° 45′ s.	4	29.91	54	57	“	20	Cloudy.
		8	29.93	54	56	Calm.	8	“
	Lon.	0	29.90	51	57	Nd. Ed.	1	“
	44° 15′	4	29.86	52	57	“	16	“
		8	29.86	54	56	“	25	“

ART. XX.—*Further proof of an annual Meteoric Shower in August, with remarks on Shooting Stars in general;* by EDWARD C. HERRICK.

IN a hasty communication published in the last number of this Journal, I stated my conviction of the high probability, that *there generally occurs on or about the 9th of August in every year, a remarkably large number of shooting stars.* In support of that opinion, it was shown that such a meteoric shower had been observed at that period, in at least six different instances. Since that article was written, I have continued the search, and have had the gratification of finding several additional facts, which confirm the proposition. These will be here recited.

(1.) Mr. T. Forster, in his *Pocket Encyclopædia of Natural Phenomena,* &c. 12mo. London, 1827, has a short article on meteors, which he divides into three classes. Of the third kind he says, "They are generally small, and of a bluish-white color, but their peculiar characteristic is that of leaving long white trains behind them, which remain visible for some seconds, in the tract in which the meteors have gone." * * * "*These kind of meteors abounded on the night of* 10*th August,* 1811, after a showery day." Part I. p. 40. In the same work, (p. 298,) in the *Rustic Calendar,* under date of August 10, he remarks, "Falling stars and meteors most abound about this time of year;"—and refers to *Calendar at end of Researches about Atmos. Phenom.,* and to the *Perennial Calendar.* Neither of these works is at my command. This 'Encyclopædia' is made up chiefly from manuscripts left by the author's father, T. F. Forster, Esq. who was long distinguished as an assiduous meteorologist.

(2.) In the Philosophical Transactions of the Royal Society of London, Vol. 70, (1780) is a letter from Sir William Hamilton, describing a series of eruptions of Vesuvius witnessed by him in the month of August, 1779. Not having access to the original Transactions, I quote the following extracts from that letter, through Dodsley's Annual Register, for 1780. London. 8vo.

"1779. August 9. Upon the whole, this day's eruption was very alarming: until the lava broke out about two o'clock, and ran three miles between the two mountains, we were in continual apprehension of some fatal event. It continued to run about three hours, during which time every other symptom of the mountain-fever gradually abated, and at seven o'clock at night all was calm. *It was* *universally remarked, that the air this night, for many hours after the eruption, was filled with meteors, such as are vulgarly called falling stars; they shot generally in a horizontal direction, leaving a luminous trace behind them, but which quickly disappeared.* The night was remarkably fine, starlight, and without a cloud. This kind of electrical fire seemed to be harmless, and never to reach the ground."—*Ann. Reg.* pp. 81, 82.

It is scarcely possible that these meteors came from Vesuvius. The writer says expressly, that at 7 at night all was calm, and gives us no intimation that there were, after that hour, until the morning of the 11th, any signs of disturbance in the mountain. If these bodies proceeded from the crater, they must have been visible in their ascent. Moreover, had they been either incandescent or burning particles ejected from the volcano, they must have fallen to the earth.

The constant expectation of a new volcanic eruption, doubtless induced many persons to maintain a vigilant watch during the night, and thus they happened to witness this display of shooting stars, which might otherwise have passed unnoticed.

(3.) The following extracts are taken from the "*Results of a Meteorological Journal for August,* 1826, *kept at the Observatory of the Royal Academy, Gosport, Hants,*" contained in Taylor's Philosoph. Mag. and Journal, 8vo. No. 341. London, Sept. 1826. Vol. 68.

"This high mean temperature is chiefly owing to the warm and sultry nights in which meteors were frequently seen. *In the night of the* 10*th instant, from* 9 *till* 12 *P. M., there was a fine display of meteors in all directions, amounting to* 42*;* the lower ones appeared the largest and most luminous, and several left long sparkling trains behind them. It is remarkable that these meteors appeared almost at regular intervals, viz., three, four, and sometimes five, in quick succession about every quarter of an hour. There were dark horizontal beds of cirrostratus of an electrical appearance moving about at the time, which with freshening breezes from the westward, seemed to favour their appearance. Two brilliant meteors, each about four inches [!] in apparent diameter, were also seen here in the nights of the 18th and 27th. They descended comparatively slow from an alt. of 44° or 45°, and in the mean time each separated into two distinct meteors before they disappeared. According to observations made here for some years past, meteors have been more prevalent in August, than in any other month." pp. 237, 238.

(4.) In the Philosophical Magazine and Journal, 8vo. London, No. 277, May, 1821, Vol. 57, p. 346, is a "Series of Queries regarding Shooting Stars and Meteors," by John Farey, Sen., in which he furnishes evidence that *on the night of August* 9, 1820, *there was seen at Gosport, a very unusual number of shooting stars.*

The following statements are from the remarks prefixed to the queries.

> "Under the head of 'Atmospheric Phænomena' [in the Annals of Philosophy] the Doctor [William Burney, of Gosport] has of late years recorded the number of his observations on small *Meteors* or *Shooting Stars:* these, in the year 1820, were in January 7, Feb. 2, Mch. 1, Ap. 2, May 2, June 1, July 15, Aug. 80, Sept. 10, Oct. 4, Nov. 2, and Dec. 5; making 131 in this year: in 1819 the annual number of each observations was 121.
>
> "The singular fact, of the month of August having furnished so very disproportioned a number of these observations, is accompanied by the mention, that 35 *of these were observed in one hour, which preceded midnight on the 9th of August* last;—they shot in different directions, and three of them whose visible paths lay between the constellations *Lyra* and *Ursa Major* were caudated or appeared with tails; and the Doctor adds 'their sparkling trains having been left brilliantly illuminated, for several seconds of time subsequent to the disappearance of the ignited bodies: this indeed was the grandest display of meteors we ever remember to have seen in so short a period, arising from the very gaseous or inflammable state of the air.'"

The two latter instances (1826 and 1820) may by some be deemed not at all uncommon; but it must not be forgotten that all the records of meteors seen at Gosport are most wonderfully diminutive. It is perfectly certain that these displays far surpassed any appearance of the kind, observed in those two years. During the entire year 1820, 131 meteors only were registered at that place; in 1819, 121; in 1824, 100; and in 1825, 159. In each of these years, August is the most fertile month. It is not easy to imagine how so few only could have been seen by a person who took any notice of them whatever.

(5.) *An unusually large number of brilliant meteors or shooting stars was seen in different parts of this country on the night of August* 10, 1834. The quotation below given in evidence is taken from the meteorological record of Dr. Henry Gibbons, whose writings evince him to be an attentive and faithful observer. The observations were made at Wilmington, Delaware (N. lat. 39° 41′, W. long. 75° 28′) and published in "The Advocate of Science and Annals of Natural History." 8vo. Philadelphia, Vol. I, 1834, p. 179.

> "On the evening of the 10th of this month (August), and until it became cloudy next morning at 4 o'clock, an unusual number of brilliant meteors were visible. Their course at first was from north to south, and afterwards from east to west. Two or three were sometimes observed in a minute. On the night of the 11th they were again visible. I find by an account in some of the newspapers, that the same phenomenon was observed at Cincinnati, Ohio, on the same nights."

vations made at Cincinnati.

(6.) Mr. Luke Howard, in a meteorological table in Thomson's Annals of Philosophy, Sept. 1813, p. 240, reports, "1813, August 11. A Stratus after sunset, with Cirrostratus remaining above. *Small scintillant meteors now appeared, falling almost directly down, and seeming to originate very low in the atmosphere.*" As Mr. Howard, in his journal published in the Annals, rarely notices these meteors, it is probable that if they had not been on this occasion, uncommonly numerous, they would not have been mentioned.

(7.) For the following additional paragraph concerning the meteoric display seen at Breslau, on the night of August 10, 1823, I am indebted to Prof. Elias Loomis, of Hudson, Ohio, whose library contains a copy of Brandes's work on shooting stars.

> "This evening was so still, the air so mild, and the heavens, though not entirely free from clouds, so rich in shooting stars, that even travelers, who felt no particular interest in these phenomena, had their attention attracted by the numerous and large fiery meteors." p. 9.

The above shows plainly that on this occasion the meteors were much more than usually abundant and brilliant. It is interesting to note that on the evening of the 8th next previous, the number seen at Breslau was above the average. No observations are given of the evening of the 9th, which may have been cloudy.

(8.) The meteoric shower of last August (1837) was more splendid than I before supposed. From a gentleman of this city who was abroad very early on the morning of the 10th, I learn that at about 3 A. M. he saw within ten minutes, in an eastern region of the sky, which comprehended not more than a fourth part of the hemisphere, at least fifty shooting stars. Many left brilliant trains, and three were often visible at once.

On the night of August 10, 1837, there was also an unusual display of meteors, but invisible here, as our sky during that night was entirely overcast. By permission of Professor Silliman, I copy the following from a recent letter to him, written by Mr. Davis B. Lawler, of Cincinnati, Ohio.

> "On the night of the 10th of August last (1837), being at Springfield, in this State, about 70 miles N. N. E. of this city, sitting at the front of the hotel there in the evening with some friends, between the hours of 8 and 9 P. M. we were all struck with the uncommon number and brilliancy of the meteors or falling stars, which made their appearance, and commanded our attention without being

some of them very large and splendid. No watch was kept for them, and no particular attention paid to them, and we soon retired into the interior of the house. The air was uncommonly transparent and the moonlight bright."

(9.) The display of shooting stars described in the following extract, must have been one of uncommon numbers, and although the time does not correspond with the other dates within a week, yet the case deserves to be copied in this connection. If the times of the occurrence of the meteoric showers have gradually changed within six hundred years, it is highly important that we should know it. The quotation is from *Matthæi Paris Historia Major, etc. Ed. W. Wats, S. T. D. fol. Lond.* 1640. p. 602.

A. D. 1243. "Et eodem anno, videlicet septimo Calend. Augusti, fuit nox serenissima, aërque purissimus, ita quòd Lactea, sicut solet placidissima nocte hyemali contingere, manifestè apparebat, Luna existente octava. Et ecce stellæ cadere de cœlo videbantur, velociter sese jaculantes hac et illac. * * * In uno instanti, præter solitum, triginta vel quadraginta saltitare vel cadere viderentur; ita scilicet, quòd duæ vel tres simul uno tramite, volare se mentirentur. Unde, si veræ stellæ fuissent, (quod nullius sapientis est sentire) nec una in cœlo remansisset. Considerent Astrologi, quid hujusmodi portentum significet: sed omnibus intuentibus, videbatur nimis stupendum et prodigiosum."

This date is the 26th of July of the Julian style, and consequently about the 2d of August of our present calendar.*

(10.) Observations on shooting stars have of late engaged the attention of persons in various parts of Europe. The September No. (1837) of the Lond. and Edin. Philos. Magazine, which has recently arrived, contains three articles on this subject;—one by M. Wartmann, of Geneva, and two by M. Quetelet, of Brussels. The following quotations from the latter show that the author suspects a meteoric shower in August.

"M. Sauveur stated that being on the road from Brussels to Liége, in the night of the 8th of last August (1836) he observed a considerable number of shooting stars, of which several were remarkable for their size and brilliancy. M. Quetelet suggests that this epoch presents a singular agreement with that of the 10th of August, which the results of observations of shooting stars, point out as one of those which are to be remarked for the abundance of meteors of this kind." p. 270.

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* There are on record several other well-marked instances of ancient star-showers, some of which it may be difficult to reconcile with the periodic times of the present day. If their dates are truly given, these displays have happened, at various times between A. D. 764 and 1243, in the months of March, April, October and December. There seems however good reason to suppose that the meteoric showers of antiquity did in fact occur at times of year somewhat removed from the present periods. A statement of these instances, with an inquiry into this change of period, may be expected in the next volume of this Journal.

"It would seem that a cause exists which produces from about the 8th to the 15th of November, more frequent appearances of shooting stars. I have also thought that I remarked a greater frequency of these meteors in the month of August (from the 8th to the 15th)." p. 272.

From the preceding statements it then appears, that *on or about the 9th of August, in at least eleven different years* (viz. A. D. 1779, 1781, 1798, 1811, 1820, 1823, 1826, 1833, 1834, 1836, 1837) *there has occurred a meteoric shower*, or in other words, an unusually abundant display of shooting stars.

As no observations have yet been made for the purpose of detecting the August shower, it is somewhat remarkable that so many instances have been recorded. It should be noticed, that these August showers have rarely been watched later than midnight. Since shooting stars are found to come mostly from that region of the heavens towards which the earth is moving, it cannot reasonably be doubted that each of these displays would have been found to be more abundant, during the hours of the next morning. That region, (which for brevity may be called the *tangential region*,) rises of course about midnight, and comes to the meridian about 6 A. M. The memorable storm of stars of November, 1833, scarcely commenced before 11 P. M.; and it is altogether probable, that every November meteoric shower which has occurred since that year, would have passed unseen, had not special watch been maintained after midnight.

Characteristics of the August Meteoric Shower.

1. This shower appears to be longer than that of November. As far as can be gathered from the accidental observations hitherto made, its duration may be considered about three days. It may perhaps be found to extend through ten or fifteen days, and to arrive at its maximum about the ninth. See 1, 3, (1), (5), (6), (7), (8).

2. The 'radiant,' or apparent starting point of the meteors, appears to be farther north than in the November shower. On this point, however, nothing positive can be stated without more observations continued during the whole night. See Mr. G. C. Schaeffer's paper, p. 133 of this volume, and 3, (5).

3. Although its displays are in general superior to those of the November shower, yet it seems never to have risen to the mag-

nificence to which both the November and the April showers have occasionally attained.

On the number of Meteoric Showers in a year.

Three during the year may be considered as well established, viz. those of November, August and April. Of the latter, however, our knowledge is lamentably defective. It is certain that an unusual display of shooting stars was witnessed in this country about the last of April, 1803, and that very extensive meteoric showers occurred in April, A. D. 1095, and 1122. No proper efforts to discover the April shower have to my knowledge yet been made. A careful look out should be, and probably hereafter will be kept up, for ten days before and after the 30th of that month.

Having looked through many hundred volumes in search of meteoric showers, it seems to me rather improbable that any fourth periodical time will be found. There are however several uncertain statements which afford some slight reasons for supposing, that there may be a meteoric shower about the middle of February, and also about the middle of June. As the phenomenon is one which in most cases would escape ordinary observation, we must look for our evidence chiefly to the future. If the showers of A. D. 902 and 1202, now referred to October, (new style,) should be found correctly stated, then we shall be obliged to admit that in *these* two years a meteoric shower occurred in October; and we ought to lose no opportunity for ascertaining whether their successors can now be discovered.

On the nature, motions, and numbers of Shooting Stars.

Shooting stars are without doubt cosmical or celestial bodies, and not of atmospheric or terrestrial origin. No plausible reasons for the common supposition that they are particles of electricity, or in some way the result of electrical action, have, to my knowledge, ever been advanced.

If we consider them as a class of bodies wholly distinct from meteorites, then we have no knowledge of their constituent elements. The different colors and appearances which they present, clearly indicate however that they differ in constitution. The majority are white, many are yellowish-white, some are red, and a few are green. They probably also differ in density;—some appear to us like mere streaks of phosphoric vapor; others seem to be solid balls of fire, and leave behind them trains of scintillations, which are sometimes iridescent. These trains not unfrequently retain their lustre and their position several seconds, which, considering the excessive tenuity of the atmosphere at the place, is a fact quite unaccountable. I know of nothing which renders it at all improbable, that meteorites and shooting stars are bodies of the same class and have a common origin. No one can by the eye discriminate between them.

By well-planned simultaneous observations in distant places, Brandes* has proved that shooting stars come principally from that part of the heavens towards which the earth is tending. He has also proved that they do sometimes *actually move upwards.* This apparently anomalous motion is easily explained. His observations were made commonly between 9 and 11 P. M., when of course the tangential region is beneath the horizon; so that a meteor coming from that region must, if it comes into our field of view, move upwards. Observations made in this city on various days of the present month, between 7 and 10 P. M., show that at this season at least, three fourths of the shooting stars visible here at this time of day, move from the N. E. quarter towards the S. W. If the premises first stated are true, the reasons for this general tendency are sufficiently obvious. At a corresponding south latitude, we might expect this tendency to be from the S. E.

It must ever be exceedingly difficult to determine the velocities of shooting stars, and the statements on this point are not satisfactory. If their rate is found to be from 18 to 36 miles a second, it seems necessary to suppose that they move in a direction contrary to that of the earth's motion.

Shooting stars are wonderfully numerous. Leaving out of consideration the myriads which fall during the meteoric showers, *the average daily number for the whole globe is at least two millions.* It is of course impossible rigidly to determine this number; but there is no difficulty in showing that this statement is probably far within the truth. 1. The average number visible per hour at one place, M. Quetelet, who has devoted much attention to the subject, states at *sixteen.* This calculation is based on observations made in Germany and in Belgium, but there is no reason for supposing that part of the world to be particularly favored in this respect. In fact these meteors are, according to scientific travelers, much more abundant within the tropics than in higher latitudes; and Capt. Parry speaks of them as not uncommon in the extreme north. This average number, however, appears to be the result of observations made before midnight, when of course shooting stars are least numerous, and also to be founded on the assumption, that "a single observer or several observers directed towards one and the same region," can detect half of the whole quantity visible at one place. This number is therefore too small. Observations made in this city, at various times in November, 1837, by three observers, (a number insufficient to secure all) give an average of rather more than 20 per hour.* Other observations justify the assumption of this number, as a fair hourly mean. During the entire day then, 480 might be seen at one place if superior lights did not interfere. 2. The distance at which shooting stars are ordinarily seen, I take at one hundred miles. A few may be seen at a greater distance, but very many more are probably invisible at fifty miles, and some, according to Quetelet, are discerned only by the telescope. Let this area be taken at 32,000 sq. miles. 3. The earth's surface contains at least 196,800,000 sq. miles, and there are consequently upon it 6150 such areas. The latter number being multiplied into 480, we have 2,952,000 as the daily number for the whole earth. This is an *average.* The actual number on any one day, (omitting the three yearly showers,) may be one fourth more or less than this.

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* A valuable abstract of Brandes's account of his observations, was published by Prof. Loomis, in Vol. 28 of this Journal, to which I am chiefly indebted for my information concerning those researches.

The source of these meteors must be of vast extent, to be able to sustain for thousands of years such incessant and enormous drafts. It seems not unreasonable to suppose, that, in a long course of time, the amount of matter resulting from the combustion of these meteors must be very considerable.† Some may ask whether, if these bodies meet the earth advancing in a direction opposed to their motion, they must not deprive it of some small portion at least of its projectile force, and thus shorten the year? Past observation answers in the immediate apprehension.

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* More observations on this point, in all parts of the world, at all times of the night and of the year, are much needed. Nine observers at one place are required to do full justice to the subject; yet four persons might probably see about three fourths of the whole visible number.

† Prof. Rafinesque's "Thoughts on Atmospheric Dust," Vol. 1, p. 397 of this Journal, may be profitably consulted in this connection. See also Webster's Hist. of Epidemic and Pestilential Diseases, Vol. 2, p. 91.

On the theory of Shooting Stars.

In the present very imperfect state of knowledge concerning many of the phenomena of shooting stars, there is much hazard in proposing any hypothesis on the subject. Without further observations, it is indeed impossible to state more than a small part of the conditions which a theory ought to fulfil. Besides accounting for the meteors of daily occurrence, it should explain the reasons for their appearance in unusually large but varying quantities every year, (or at least for many years in succession,) certainly at two periods in the year, viz., about Aug. 9, and Nov. 12, and probably also at a third, viz., about the last of April. The various characteristics of the November shower have been stated at large by Prof. Olmsted and Mr. A. C. Twining, in preceding volumes of this Journal; those of the August shower, (so far as they are known,) are contained in the present volume.

It is not impossible that these meteoric showers are derived from nebulous or cometary bodies with which, at stated times, the earth falls in. This hypothesis, however, does not satisfactorily account for the meteors of daily occurrence.

M. Arago (Comptes Rendus, 1835, pp. 394, 395. 4to. Paris,) proposes the hypothesis of an immense zone or ring, composed of millions of small bodies or asteroids, revolving about the sun, whose orbits meet the plane of the ecliptic at that part of the path of the earth, which it occupies from 11th to 13th November. This hypothesis, in some shape, will probably be found adequate to account for all the phenomena.

The facts at present known, seem to require that the earth should pass through some part of this zone in November and in April; and approach in August sufficiently near it, to receive an unusually large quantity of meteors. It is also necessary that the earth should constantly keep very near it, in order to obtain its daily supply. If however additional periodic showers should be discovered, it might be difficult to account for all by one such zone.

This zone probably lies partly within and partly without the orbit of the earth. When the earth is in that part of its orbit which is *exterior* to the zone, we might expect by the aid of the telescope, occasionally to detect these bodies passing across the disc of the sun. Owing to their distance and comparatively small size, they might however, while in their celestial courses, be totally invisible. Frequent observations of the sun, for the purpose of detecting these transits, are highly desirable. The only important facts known to me, which relate to this point are these:—on the 17th June, 1777, Messier saw myriads of small dark bodies passing over the sun; and at Geneva, May 19, 1830,* from 1 to 2 P. M., multitudes of "small luminous emanations" were discovered passing across the field of a meridian telescope. Both these facts are of great value and deserve attentive consideration.

When the earth is in that part of its path which is *interior,* it might not be unreasonable to suppose that we should see the zone by reflected light; but while we are ignorant of the density, numbers, size and distance of the bodies which constitute it, we cannot assert that it ought to be visible.

The only known celestial appearance to which this zone can be referred is the *Zodiacal Light.* Our great distance from the equator renders it impossible for us to make observations upon this light, which will determine whether its position at various periods of the year is such as to permit us to consider it the source of shooting stars. Satisfactory observations can be made only at or near the equator.

The limits which circumstances prescribe to this article, compel me to omit the consideration of many important particulars relating to this subject, and to speak of others with too much brevity.

My thanks are due to Prof. B. F. Joslin, for the important assistance which he has afforded me in relation to this inquiry; and also to various friends in this city, especially to Messrs. A. B. Haile and J. D. Dana, for whose coöperation and counsel I am under great obligations.

New Haven, Conn. Nov. 29, 1837.

P. S. Since the preceding article was written, I have, through the kindness of Mr. R. W. Haskins of Buffalo, N. Y., been furnished with his translation of M. Arago's reports to the Academy of Sciences, at the sessions of August 14 and 28, 1837, concerning unusual numbers of shooting stars seen that month in various parts of Europe. The translation is published in the Buffalo Daily Commercial Advertiser, of Nov. 25, 1837. There is no room to quote it here. With a single exception, its statements do not contravene any fact or conclusion contained in the foregoing paper.

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* The details are related by Gautier, at p. 206 of his account of the extensive meteoric shower of Nov. 13, 1832, Bib. Univ. de Genève, 1832, Sci. et Arts, tome 3, pp. 189—207. These bodies may possibly have been in our atmosphere.

Art. XXI.—*On a large and very sensible Thermoscop'c Galvanometer;* by John Locke, M. D., Professor of Chemistry in the Medical College of Ohio.* (From the London and Edinburgh Philosophical Magazine, and Journal of Science.)

TO RICHARD TAYLOR, ESQ.

Dear Sir—The announcement of a new galvanometer will, perhaps, scarcely attract attention. But as I have been kindly encouraged by several eminent British philosophers to communicate some notice of my modification of the thermo-multiplier, I venture to send you the following sketch. Although a great labor has already been performed in electricity and magnetism, yet the adepts are aware that much remains to be executed, and that among the numerous principles already clearly established, it is probable that those proportions and arrangements which will produce the *maximum* effect have been in few instances fully ascertained. The chief novelty of the instrument which I am about to describe, consists in its proportions and the resultant effects. The object which I proposed in its invention was to construct a thermoscope so large that its indications might be conspicuously seen, on the lecture table, by a numerous assembly, and at the same time so delicate as to show extremely small changes of temperature. How far I have succeeded will in some measure appear by a very popular, though not the most interesting experiment which may be performed with it. By means of the warmth of the finger applied to a single pair of bismuth and copper disks, there is transmitted a sufficient quantity of electricity to keep an eleven-inch needle, weighing an ounce and a half, in a continued revolution, the connexions and reversals being properly made at every half turn.

The greater part of this effect is due to the *massiveness* of the coil, which is made of a copper fillet about fifty feet long, one fourth of an inch wide, and one eighth of an inch thick, weighing between four and five pounds. This coil is not made in a pile at the diameter of the circle in which the needle is to revolve, but is spread out, the several turns lying side by side, and covering almost the whole

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* Through the kindness of Dr. Locke we have received the fine instrument described in this paper, and as far as we have had opportunity to examine it, we find it to justify the statements made by its ingenious inventor.—Ed.

of that circle above and below. The best idea may be formed of the coil by the manner in which it is actually modeled by the workman. It is wound closely and in parallel turns on a circular piece of board eleven and a half inches in diameter and half an inch in thickness, covering the whole of it except two small opposite "segments" of about 90 degrees each. The board being extracted, leaves a cavity of its own shape to be occupied by the needle.

The copper fillet is not covered by silk or otherwise coated for insulation, but the several turns of it are separated at their ends by veneers of wood just so far as to prevent contact throughout. In the spreading out and compression of the coil it is similar to Melloni's elegant apparatus, though in my isolated situation in the interior of America I was not acquainted with the structure adopted in his prior invention. In the *massiveness* of the coil my instrument is perhaps peculiar, and by this means it affords a free passage to currents of the most " feeble intensity," enabling them to deflect a very heavy needle. The coil is supported on a wooden ring, furnished with brass feet and leveling screws, and surrounded by a brass hoop with a flat glass top or cover, in the center of which is inserted a brass tube for the suspension of the needle by a cocoon filament. The needle is the double astatic one of Nobili; each part being about eleven inches long, one fourth wide, and one fortieth in thickness. The lower part plays within the coil and the upper one above it, and the thin white dial placed upon it, thus performing the office of a conspicuous index underneath the glass.*

I have not yet made any very extensive experiments with this instrument, being only just now prepared to do so. It is very sensible to a *single* pair of thermo-electric metals, to the action of which it seems peculiarly adapted; but the efficiency of such metals is increased by a repetition of the pairs, as in the thermo-pile of M. Melloni, especially if they be massive in proportion to the coil itself. With a battery of five pairs of bismuth and antimony, the needle was sensibly moved by the radiation from a person at the distance of 12 feet, without a reflector, the air being at the temperature of 72°.

In a recent interview with M. Melloni, to whose politeness I am much indebted, he expressed his opinion that with a thermo-pile massive in proportion to the coil, my galvanometer might be made to exhibit his thermo-experiments advantageously to a large class. Some idea may be formed of its fitness for this purpose from the result of a single trial on "transmission." The heat from a small lamp with a reflector, at the distance of five feet, passed through a plate of alum, and falling on a battery or pile of five pairs of bismuth and antimony, deflected the needle only a fraction of one degree, but on substituting a similar plate of common salt, the same heat produced, by impulse, an immediate deflection of 33 degrees.

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* This instrument has been made by Messrs. Watkins and Hill, Opticians and Philosophical Instrument Makers, No. 5, Charing Cross.

Although the instrument is finely adapted by its size for the purpose for which it was intended, class illustration, yet from the weight of the needle and the difficulty of bringing it to rest after it once acquires motion, it is not so suitable for experiments of research as the Mellonian galvanometer. When a massive thermo-pile, such as has lately been made by Messrs. Watkins and Hill of Charing Cross, is connected with the coil and excited by a heat of about 200°, the needle being withdrawn, a distinct spark is obtained on interrupting the circuit; in producing this effect it is less efficient however than the ribbon coil of Prof. Henry. The tube for suspension, placed over the center of the instrument, is so constructed as to admit of being turned round by means of an index, which extends from it horizontally over the glass cover, and thus any degree of torsion may be given to the suspending filament or wire. A wire of any desired thickness may be easily substituted for the cocoon filament, when the instrument becomes adapted to measuring the deflecting forces of the galvanic battery. By using a thick wire it was ascertained that the calorimotor of Professor Hare, having 40 plates, each 18 inches square, acted on the needle with a force equal to 92 grains, applied at the distance of 6 inches from the center. In attempting to force the needle by torsion into a line parallel to the coil, where the deflecting current acts with the greatest strength, I accidentally carried it too far and reversed its *position*, when instantly it became reversed in *polarity*, that which had been the north pole becoming the south. This showed how unfit is the magnetic needle to measure such a quantity of electricity as was then flowing through the massive conductor. The instrument was well adapted to show to a class the experiments upon radiating heat with Pictet's conjugate reflectors, in which the differential or air thermometer affords, to spectators at a distance, but an unsatisfactory indication. For this purpose the electrical element necessary is merely a disk of bismuth as large as a shilling, soldered to a corresponding one of copper, blackened, and erected in the focus of the reflector, while conductors pass from each disk to the poles of the galvanometer. With this arrangement the heat of a non-luminous ball at the distance of 12 feet will impel the needle near 180°, and if the connexions and reversals are properly made will keep it in a continued revolution.

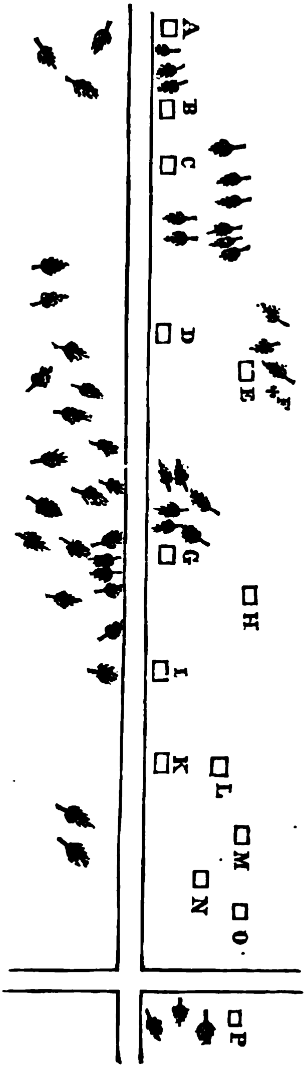
I have thus given you a brief sketch of an instrument which seems to supply a desideratum on the lecture-table, when the common thermometer is too small to afford to a class that direct and full satisfaction which, in a subject so important as that of heat, is very desirable to every professor. I have not so far attempted to use it extensively as an instrument of research, yet it shows evidently the importance of massiveness in conductors for feeble currents, such as those produced by thermo-combinations; nor am I certain that I have arrived at a maximum in this particular, for so far as I have proceeded in using thicker conductors for the coil, the deflecting effects have been increased.

I am, &c. JOHN LOCKE.

London, Aug. 30, 1837.

ART. XXII.—*Observations on a Hurricane which passed over Stow, in Ohio, October 20th,* 1837*; by* ELIAS LOOMIS, Professor of Mathematics and Nat. Philosophy in Western Reserve College.

ON the morning of October 20th, 1837, a hurricane, of destructive violence, passed over Stow, in Ohio. This town is situated about thirty miles south of Cleveland, in north latitude 41° 12′, and west longitude 81° 25′. As the hurricane occurred during the darkness of the night, we can collect little information respecting it, with the exception of the record which the wind has itself left of its progress. During the night of the 19th and morning of the 20th of October, there was a thunder shower at Stow, which extended into some of the adjoining towns. The lightning was rather vivid, the rain fell in torrents, and the wind blew fresh during most of the night. About three o'clock in the morning, a whirlwind formed near the center of Stow. It moved rapidly from west to east, over an extent of about three miles, its breadth varying from forty to sixty, and occasionally to eighty rods. For about a mile of its course, few objects were almost entirely blown down or broken off—the fences were completely scattered—the houses and barns were generally unroofed, and one house torn literally into pieces. For the purpose of rendering my description more intelligible, I have drawn a plan of that part of the hurricane's track where most of the injury was done.



A, represents a house unroofed; B, a barn partly unroofed; C, a house uninjured; D, the house of Mr. Sanford, completely destroyed; E, the barn somewhat injured; F, the spot where the cart was dropped; G, a house not much injured; H, a barn unroofed; I and K, houses unroofed; L and N, barns unroofed; M, a two-story log-house with its upper story taken off; O and P, houses uninjured. The horizontal road runs east and west; the perpendicular road runs north to Hudson.

The hurricane commenced a little west of the house A. Its violence rapidly increased as it advanced eastward, and throughout that whole part of the track which is represented in the diagram, a large proportion of the trees were leveled. Where no trees are represented on the diagram, there were very few, if any, to be uprooted. Eight buildings were unroofed; three others were considerably injured, and the remainder of those on the diagram escaped with a few panes of broken glass. But it was the house D, upon which the storm poured its principal violence. This was a small frame house of one story, and had been built but two years. It was situated upon a slight eminence or knoll, and was not protected at all from the fury of the wind. The house was occupied by Mr. Frederick Sanford, his wife and mother, with three children. On the evening of the 19th, the family were absent from home to attend a wedding. They returned about midnight, and Mrs. Sanford states that it was then raining moderately, the lightning was somewhat vivid, and the wind fresh. They retired to bed and were soon asleep. Mrs. S. relates that she was awakened from a sound sleep by a crash, which she presumes was occasioned by the falling chimney; almost at the same instant she felt that the house was moving; there was a tremendous roaring noise, and further than this she has no recollection. In the morning the neighbors found the house a perfect wreck. Not a timber was left in its place. The foundation stones were *not disturbed*, but the entire frame of the house was lifted up, and carried in the direction of the barn E. A portion of the foundation frame was dropped almost immediately, and lay but a few feet from the foundation walls. The bricks of the chimney were, most of them, carried but a short distance, and were scattered along precisely in the direction of the barn. A considerable number of bricks, however, constituting, as is supposed, that part of the chimney which rose above the roof, were carried to a greater distance, and scattered mostly in a northeast direction. The barn bore N. 29° E. from the house, as I determined it by a compass, and was distant from it twenty-five rods. This entire space was strewed with the small fragments of the furniture and timbers of the house. About half-way between the house and barn, were found three corpses horribly mangled, being the bodies of Mr. Sanford's two sons and his mother. Mr. Sanford was still breathing, but died in about an hour. Mrs. Sanford and her daughter were unable to move in consequence of bruises and broken bones. They are, however, still living, and will probably recover. Animals of various kinds were lying dead among the ruins. There were pigs, geese, hens and turkeys, in considerable numbers, and several of the fowls were picked almost clean of their feathers, as if it had been done carefully by hand. Neither Mrs. Sanford nor her daughter are able to give any satisfactory account of the hurricane, for they were both of them awakened from a sound sleep by the crash of the house, and the next instant they were dashed senseless upon the ground. I have stated that the house was carried in the direction of the barn. About half of the roof and frame fell near the S. W. corner of the barn, and some of the timbers fell near the S. E. corner. Several heavy joists lay scattered forty or fifty rods beyond the barn, but all in nearly the same direction from the house. There were several very remarkable facts, showing the power of the wind, which I should not have been prepared to credit had I not observed them for myself. I visited the spot the day after the hurricane, and have observed it once since that time. An ox-cart, before the storm, was standing close by, and in the rear of, Mr. Sanford's house, and was loaded with potatoes. The cart was lifted up by the wind; it soon turned a somerset, so as to empty out the potatoes upon the ground, and nearly all in a heap. The cart itself was dropped a few rods *behind the barn*, and at a distance of thirty rods from the house. If the cart moved in a straight line it must have passed directly over the barn. Indeed, it is quite probable that such was the case; for the cart struck flat upon one wheel which buried itself to a considerable depth in the earth. The spokes were all broken, apparently by the severity of this fall, and there is no appearance of the cart's having been injured previously to the fall, with the exception of the loss of the boards which lined the body. There are no marks of the cart's having been dragged along upon the ground, but on the other hand, the wheel imbedded in the earth shows that the cart fell nearly perpendicularly, and from a considerable height. It is then probable that it passed directly over the barn. There was a heavy drag, moreover, taken from nearly the same spot with the cart, and which also fell by its side beyond the barn. The roof of the barn was somewhat injured, losing some shingles and boards, and it is conjectured that the drag might have struck the roof in passing over it. I attach but little importance, however, to the question whether the cart and drag actually passed over the barn. It is at least certain, that they were transported by the wind about thirty rods, and fell from a considerable height.

A wagon before the storm was standing in front of the house by the road-side. The next morning one wheel was found in the road about thirty rods east of the house; another wheel a little farther north over the fence; the two remaining wheels at a still greater distance from the house and in the direction of the barn H. The wagon box was found half a mile distant in a northeast direction.

There is another fact which appears to my mind still more remarkable. A very heavy cast-iron plough was lying between the two houses C and D; a massive iron chain was attached to it, and there was little wood-work about it. This plough was dragged along about four rods, and ploughed into the ground in several places. In one spot it appears to have been carried almost entirely around, removing all the turf from a space about four feet square, and throwing up the earth to the distance of six feet; the plough was broken so as to be worthless. Various light objects of clothing have been found in the neighboring towns; a sheet was found in Franklin, three miles east in a straight line, and a silk frock with a bonnet was found in Streetsboro', a distance of five miles in a direction east-northeast.

My principal object in examining the ground has been to determine the direction of the wind's motion. This may be done tolerably well by observing the bearings of the fallen trees. Trees will usually fall very nearly in the direction of the wind which uproots them. I have therefore measured with a compass the direction of a very large number of the trees throughout that part of the track where the wind was most violent. On the north side of the road and close by the barn B on the west side of it, one tree fell S. 7° E., another south, and another S. 9° W. Back of the house C, the trees fell S. 42° E.; S. 31° E.; and S. 12° E. A little farther east, between the houses C and D, several apple-trees fell in the direction S. 6° E.; S. 12° E.; S. 31° E.; S. 42° E.; S. 68° E. Those nearest the road were generally more inclined to the south than those near the borders of the track, but this rule was not without exceptions. Almost exactly north from the house D and at the distance of about thirty rods, a tree fell S. 49° W. A little farther east, an old tree but a stout one fell directly towards the barn E which bore S. 16° E.; and still farther east, being directly north from the barn, and distant about twenty rods, an oak tree two feet in diameter but somewhat decayed fell S. 54° W. In this neighborhood, the whole number of trees was very small. Still further east near the house G but west of it, the trees fell S. 26° E.; S. 82° W.; N. 86° W.

the barn B, the trees were generally turned northward, but some eastward. Opposite the houses D, G and I, was a white oak forest. Here the trees were not generally blown down, but broken off at an elevation from the ground of from twenty to forty feet. The stoutest white oaks of two feet diameter were snapped like a walking cane. I measured the bearings of a large number of the fallen trunks; they were N. 56° W.; N. 46° W.; N. 32° W.; N. 31° W.; N. 29° W.; N. 2° E.; and N. 14° E. Within these limits the bearings of nearly all the trees in this forest were embraced, if we except a few which lay very near the road. Here the trees were thrown down in much greater disorder; thus, directly opposite the house G and near the road, one tree of immense size fell N. 31° W. Only two rods distant were two others of about the same dimensions which fell S. 31° E., and then another N. 31° W. Thus here were four large trees side by side with their trunks as nearly parallel as they could well be laid, while the tops of two pointed northward and those of the others southward.

The preceding observations will shew the direction of the fallen trees as compared with the track of the hurricane, for the latter was almost due east and west, not following absolutely a straight course, yet very nearly so. I have introduced the observations here for the sake of shewing how great variety there was in the bearings of the fallen trunks, and also to shew that these bearings were actually measured and not loosely estimated by the eye. A general idea of the direction of the trees will be best acquired from the diagram, in which I have attempted to represent their relative positions and bearings. It will then appear from an inspection of the diagram, that in the midst of some disorder there was a degree of uniformity. Thus upon either border of the track the trees all incline toward some point in the center of the track. There is not an example of a tree being turned outward from the track, nor even one which lies in a direction parallel to it. I except from this remark those near the middle of the path, which were subject to a different law as will presently be seen. Of all the trees situated near the borders of the track, the bearing which approaches nearest to parallelism with the track was in the case of an apple tree about half way between the houses C and D. This bore S. 68° E., differing 22° from parallelism. This is a striking result and clearly shews that the wind blew from both borders of the track towards some point in the center of the track. This remark does not apply to one part of the track exclusively, but was a general characteristic of the hurricane. Moreover, there was one spot near the house A, where the fences on each side of the road were blown into the road.

We have then I think established that there were two powerful currents of wind blowing from the opposite side of the track; that is, within a few rods of each other, and with such violence that the stoutest oaks fell before it. What then became of the air thus accumulated in the centre? It must have some escape. Was this escape in a horizontal or vertical direction? The evidence I think is sufficient to decide this question; that there was a powerful current upward from the surface of the earth near the middle of the track, is proved by the objects which were actually elevated into the air. The house D was lifted directly from its foundations. The cart which was standing near the house was raised thirty or forty feet at the least calculation into the air. The feather bed upon which Miss Sanford was sleeping, was found next morning lodged in a tree nearly between the house and the barn, and at an elevation of forty feet from the ground. A coat which belonged to one of the men of the house was lodged also in the same tree. The light articles which have been found in the neighboring towns, prove not only a horizontal current, but an ascending one sufficient to counteract the effects of gravity during several minutes.

We have now established by a fair induction, that there was a powerful current of air from the opposite sides of the track towards some point in the centre of the track, and that here there was also a powerful current upward. What was the nature of this ascending current? Was it accompanied by gyration? This question I think we are able to answer. The furniture of the house D, was scattered in very various directions. The house itself and the more substantial part of the furniture were carried in the direction of the barn; portions of the wagon however, lay strewed in every direction from east to northeast; leaves of books were found attached to bushes by the road in an east direction; a tin pail and various light articles were found in the woods opposite the house G, and in a direction S. E. from D; and a piece of a clock was found in a N. W. direction from D, in the apple orchard. The plough which was between the houses C and D, was obviously carried round nearly an entire circumference, for it left clear marks of its course on the ground. We find the same evidence of a gyral motion in the directions of the trees which fell near the middle of the track. Take the case of the four trees I have mentioned in front of the house G. They lie parallel to each other, side by side, and fell nearly at right angles to the track of the hurricane. Yet the tops of two of them incline to the north, and those of the other two to the south. Here there were two winds which blew, we cannot suppose simultaneously, but successively, from opposite points of the compass at the very same spot, and the two winds must have succeeded each other at an interval not exceeding a minute, for the violence of the hurricane was past in about that time. The preceding, moreover, is a phenomenon which occurred not in one spot merely, but all along the centre of the track. Every where there is the same evidence of two currents in exactly opposite directions, having passed over precisely the same spot. I know of but one supposition which will explain all these phenomena ; viz. that the air near the centre of the track had a whirling motion. A tree then which was levelled as this whirl was approaching it, would be turned to the right for example ; and another which fell as the whirl was receding would be inclined to the left; so that we might have trees side by side, lying parallel to each other, but with their tops turned in opposite directions conformably with the observations. It appears, however, that this whirl did not extend over the breadth of the entire track, for then trees must have every where fallen, occasionally at least, parallel to the track, a fact which has been observed only near the middle of the path.

We are now I think, in a situation to explain nearly all the phenomena which have been observed. The wind blew from the opposite sides of the track, and doubtless from every point of the compass, towards some point in the centre of the track; here the wind rose violently with a gyral motion. This vortex itself had a rapid motion from west to east, sweeping along over the middle of the hurricane's path. Trees then upon the borders of the track would every where fall towards this vortex. Those which were prostrated as the vortex was approaching, would have an inclination to the west; but those which fell as the vortex was receding, would be found inclined to the east, and we should no where find trees falling outward from the track or even parallel to it. All this is in exact conformity with the observations. We may now, moreover, explain a fact which at first view might have seemed quite anomalous, viz. that the house D' was carried in the direction of the barn, while a tree behind the barn fell towards the house. At the surface of the earth the wind must have brought much nearer the magnet than is represented in the figure; at the same time the friction is trivial. The apparatus would be much improved by the addition of another bar magnet *n′ s′* above the coil. In that case the magnetism of both bars might be preserved, by arming their opposite poles when not in use. This instrument, though interesting, is not intended as a measurer of galvanic force. But the principle of making the conducting wires the indicators instead of the magnets, appears to be of value, for many reasons. The conducting wires may be considered as perfectly astatic, and affording constant results. It is difficult to obtain, and much more so to preserve a perfectly astatic needle. The needle of a galvanometer is readily disturbed by the approach of any ferruginous body. By substituting for the dissected cylinder at *a* two entire cylinders above and below, the rotary multiplier becomes a galvanoscope of considerable delicacy. In order to constitute an astatic galvanometer the whole should be inverted, the magnets supported from below, the multiplier by a torsion thread from above, and the extremities of the wire turn in small mercury cups in the centre of motion.*

Fig. 2, represents a new form of electrepeter. Its name purports a turner or changer of the electrical current. An ingenious apparatus of this kind, by Mr. Clarke of London, is described and figured in the first No. of Sturgeon's Annals; but it is not so simple in construction, and the connecting wires in his machine being out of sight, it is not so easily understood as the one here figured. The drawing represents a double electrepeter, or one to be used with two separate batteries, and two or more pieces of electro-magnetic apparatus. Divide the machine at *a*, and bring up the wooden pillar *r* to the left hand division, and you have the single electrepeter, answering for most purposes. The one I have constructed, was made for reversing the motion of an electro-magnetic engine, and has four parts. *a c* is a cylinder of mahogany ¾ inch diameter, mounted for semi-rotation between two wooden pillars. *b b b b* represent strips of silver passing each obliquely half round this cylinder, and fastened to it by pins of the same metal. *b′ b′ b′ b′* represent rectangular studs of silver, (copper will answer, but not so well,) connected metallically through the centre of the cylinder with

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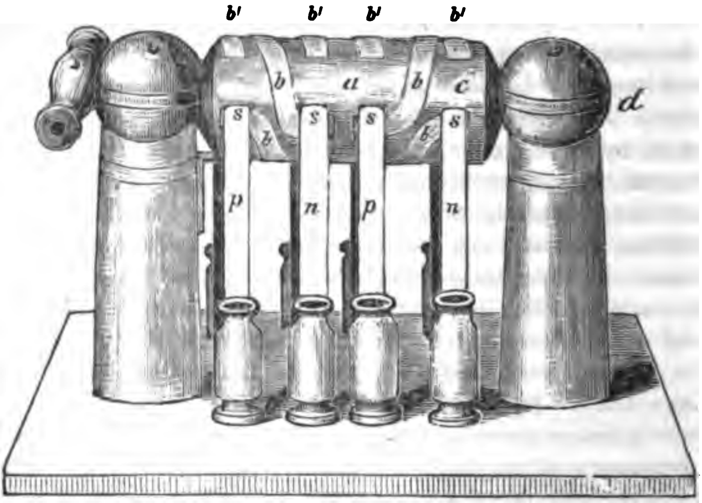
* The wires here should be of silver, except the tips for the mercury connexion.

Fig. 2.



corresponding studs directly opposite. *p s*, *n s*, are stiff springs of copper, with silver tips at *s* pressing firmly against the studs on the cylinder, and connected with the mercury cups below. The back side of the instrument exactly corresponds to that exhibited in the drawing. The modus operandi is seen at a glance. The two springs *p n* are connected by the mercury cups with the poles of a battery. The corresponding springs of the other side, with the wires of an electro-magnet for instance. By turning the cylinder half round, it is obvious the battery current is crossed, and the poles of the magnet *reversed.*

New form of interruptor or electrotome.—As it is desirable that every distinct form of apparatus of general use should have an appropriate name, I have selected the term electrotome (divider of the electrical current) as applicable to the several varieties of apparatus figured and described in the July No. (1837) of your Journal. It is hardly necessary to premise, that secondary currents of great intensity, are obtained from a single pair of plates in connexion with the dynamic multiplier, when the primitive current is divided in any part of its course. The force of the secondary current so obtained, depends materially upon the mode of breaking the circuit of the primitive. The shocks and decompositions I have found to be greatest when the primitive circuit is broken by raising clean pencils of lead, zinc or copper, from the surface of mercury covered with lead. The mechanical electrotome I have contrived with a view to combine the above advantages, at the same time that it is a useful instrument, affords a most brilliant exhibition of galvanic power. The connexion is rapidly broken by a long series of leaden bars, raised from the surface of mercury in succession by pins arranged at proper distances on a revolving metallic drum, similar to that of a barrel organ or musical box. The lead bars, or wires, of large size, are supported in a wood frame by projecting shoulders, to take the pins of the drum as it revolves. Their lower ends just dip into the mercury of a long narrow cell with glass sides. The drum is connected with the battery by a strip of copper pressing firmly against its metallic axis. The mercury in the cell is connected with the spiral by a wire. As the pins come round in successive order, they establish the battery connexion, and again break it by raising the piece of lead, and so each one in order. Revolved by a multiplying wheel the effect is exceedingly beautiful, while, in the dark, illuminated by its own light, the whole appears to be at rest.

MISCELLANIES.

DOMESTIC AND FOREIGN.

1. *On the Meteoric Shower of November*, 1837.

By Denison Olmsted, Professor of Natural Philosophy and Astronomy, in Yale College.

1. *Observations made at Yale College.*

Although, in conformity with a remark made in my account of the meteors of November, 1836,* I had little expectation of a repetition of the same phenomenon the present year, unless on a very limited scale, yet it was deemed proper to take such measures as would insure a full knowledge of the facts of the case, whatever they might be. Accordingly, I made early arrangements with a number of my young friends, who are conversant with the stars, deeply interested in the studies of nature, and much accustomed to astronomical observations, to maintain a strict watch during the whole of the night, between the 12th and 13th of November, and to have an eye upon the stars, especially the latter half of each night, for several nights preceding and following that.

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* American Journal, vol. xxxi, p. 386.

In order that every part of the firmament might receive its due share of attention, our company, eight in number, divided itself into four parties, allotting two to each quarter of the heavens. To Mr. *R. B. Claxton* and myself was assigned the southeastern quarter; to Messrs. *A. B. Haile* and *E. C. Herrick*, the northeastern; to Messrs. *E. Strong* and *D. T. Stoddard*, the northwestern; and to Messrs. *H. L. Smith* and *E. P. Mason*, the southwestern. Each party selected a separate station for itself, and arranged to keep an accurate record of its observations.

The early part of the evening afforded some signals of promise. A copious rain which fell on the preceding night, attended by an easterly wind, had given place to a serene sky with the wind at the west; from the setting sun diverged six large columns of a rose colored vapor; and, before six o'clock, an auroral pillar of a crimson hue presented itself in the northwest; but before seven o'clock, every unusual appearance had vanished and left an unclouded sky. The full moon, however, shone with so strong a light as almost to hide the stars, permitting none to be seen below the third magnitude, and scarcely any indeed at so hasty a glance as the eye must take to observe the transient flash of ordinary shooting stars. Of course, no meteors but those of unusual brightness could be seen.

From the early part of the evening, a constant watch was maintained; but the several parties were not at their respective posts until about midnight. From this period, until broad day light, the observers were constantly in the open air, gazing, without intermission, upon the quarter of the heavens respectively assigned to them.*

No shooting stars were observed until five minutes past one o'clock, when they began to appear at considerable intervals. On collecting and comparing all the observations, we arrived at the following results.

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* We should not have thought it necessary to trouble the reader with the narration of all these circumstances, except by way of apology for having seen more shooting stars than were seen in other places. To some who have averred that there were on that night few or none to be seen elsewhere, but have ascribed the favors so much more freely bestowed here to the courteous attention paid them on former visits, we would respectfully recommend, that hereafter they use the ceremony to meet these celestial visitants out of doors, and in full dress. A constant gaze with the neck bent backwards, for six hours or more, in a frosty night, is the kind of etiquette they exact.

I. Number.

Time.	S. E.	N. E.	N. W.	S. W.	Total.
1h—2h	8	3	6	3	20
2—3	8	4	9	2	23
3—4	26	22	3	7	58
4—5	26	16	12	10	64
5—6	28	18	8	8	62
6—7	3	. .	. .	. .	3
Sum total,	99	63	38	30	230

Remarks.

1. On comparing notes, it was found that four meteors had been counted twice; these being deducted, the entire number is 226.

2. The greatest number were observed in the *southeast*, and the the least in the *southwest*, the former being more than three times as numerous as the latter.

3. Including all the observations, the *maximum*, or period of greatest frequency, occurred from 4 to 5 o'clock; but this was not uniformly the case in the several quarters taken separately. Thus, in the *southeast*, the most productive hour was from 5 to 6; in the *northeast*, from 3 to 4; in the *northwest* and *southwest*, from 4 to 5 o'clock. The maximum of the meteoric showers of November of previous years has been, always and in all places, about 4 o'clock.

4. In numerous instances, after a considerable interval, several meteors would start about the same time, from the same part of the heavens, falling in different directions. Thus, at 3h. 47m., four started almost at the same instant from Jupiter, then situated a few degrees east of Regulus.

II. Courses.

1. Of the 99 meteors which were observed in the S. E., 42 fell between E. and S., and 29 between E. and N., the remainder passed in different directions.

2. *Seven* were observed to *rise*. The particulars are subjoined with the hope of instituting a comparison with observations made elsewhere.

1h. 23m.	from	μ Leonis, (very bright.)
1h. 26m.	"	breast of Leo, (observations not definite.)
1h. 39m.	"	Pollux.

2h. 25m.	from	hind foot of Ursa Major.
3h. 35m.	"	Leo, (very bright.)
3h. 40m.	"	Ditto.
4h. 11½m.	"	Castor.

3. All the meteors, with the exception of ten or twelve, proceeded in lines of direction which diverged from the constellation Leo. Those which did not follow this regimen, were marked in our records as *unconformable*. They were generally remarked as having a *slower motion* than the others, particularly when moving horizontally from west to east. Each of our four parties made a separate location of the apparent radiant, and, on comparing notes, it was found that all agreed in placing it *somewhere* between ε and γ Leonis. It was conceded, however, that those whose attention was constantly directed towards the eastern quarter of the heavens, had better opportunities than the others, for determining this point with accuracy. The position of the radiant was at first near the star μ of the Lion, but afterwards moved southward and eastward a little, and soon after three o'clock, became stationary nearly equidistant from and μ.*

Position of the radiant in successive years.

1833,	R. A.	150° 00′	Dec.	20° 00′
1834,	"	144° 30′	"	30° 15′
1836,	"	145° 00′	"	25° 00′
1837,	"	146° 00′	"	24° 30′

III. MAGNITUDES.

1. It must be recollected, that a full moon was shining with so strong a light as to extinguish all stars below the third magnitude, and consequently, that none but very bright meteors could be seen at all. About 40 were of such a size and splendor, that they might be compared to Venus and Jupiter. These in a dark night must have been very splendid fire balls. The greatest part, however, were much smaller, and many were mere momentary flashes.

2. The major part of the meteors were followed by *trains*. These appeared to be, in most cases, merely the continued impression of light on the eye, resulting from the great velocity of the bodies; but

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* This change of the place of the radiant was, we learn, also noticed by Mr. F. A. P. Barnard, of New York.

doubt of its being a deposit of luminous matter. It must evidently have required a train of singular brightness to have overcome a moonlight so strong, that a newspaper could easily be read by it. We will add, for the sake of comparison with other observers, the particulars of a few of the meteors most remarkable for the length and splendor of their trains.

1h. 40m.—From near ξ Leonis, length 45°.

2h. 42m.—Origin, 3° N. of Capella, extinguished 6° N. of Alpha Arietis—as large as Jupiter—train writhed for 3 seconds and then faded away.

4h. 6m.—Origin in the head of Perseus—extinguished near Mirach—brilliant train of 20°—remained 3 seconds.

4h. 59m.—Course towards Procyon—train 6° and swelled out in the middle.

5h. 6m.—Origin 4° above γ Leonis—extinguished 5° above δ Canis Majoris—length of train 16°—meteor as bright as Sirius.

IV. Velocities.

The velocity of most of the shooting stars was surprisingly great, the time of flight being in many cases not more than a quarter of a second, and rarely exceeding a second. It has already been remarked, that such as moved horizontally from west to east had a comparatively slow motion. On the evening of the 16th of November, at 10h. 25m., I saw a large dull red meteor sailing along the southern sky from west to east, at an elevation of 20°, which occupied 10 seconds.

2. *Observations made in various other places.*

I learn from abroad, that on the night preceding the 13th of November, a careful watch was maintained in various parts of the United States, both at literary institutions and by private individuals. Such results as I have been able to ascertain from the public papers, and from numerous communications obligingly made, either to myself or to my friends, Prof. Silliman and Mr. E. C. Herrick, I proceed to lay before the reader, regretting that the limits of this article do not permit the insertion at large of the copious documents in my possession.

In the *city of New York*, a strict watch was maintained by Mr. *G. C. Schaeffer* and Mr. *F. A. P. Barnard*, both well known as wholly independent of each other. Mr. Schaeffer saw none until 2 o'clock, but from this time until sunrise he counted 70, most of them in brilliancy equal or superior to the brightest fixed stars, many of them leaving trains of considerable length. The point of radiation was nearly, if not quite, in the same place as in November, 1833. (*New York American.*)

Mr. Barnard counted between 40 and 50 shooting stars, between 2 and 6 o'clock. Most of them left behind them trains of great beauty. Many of the fainter kind were not included in this estimate. The meteors were most frequent from half past three to half past four. The first one that was observed, of very uncommon splendor, fell eastwardly, between Denebola in the tail of the Lion and the planet Jupiter, at about 20 minutes before four. But the brightest of all, and the most beautiful one he ever saw, occurred just about 5 o'clock, falling eastwardly also, near *Theta Leonis.* Its brightness was dazzling like that of the sun, and its size two or three times that of Jupiter. It left a magnificent train. Two or three usually fell about the same time, after which there generally occurred an interval of from five to fifteen minutes, in which none were observed. The display continued until all the stars were swallowed up in the broad light of day. All the meteors, traced back by the eye, seemed to proceed from a radiant point due north of *Regulus*, and between *Eta* and *Zeta Leonis.* They moved in all directions, but mostly on the east side of a meridian passing through the radiant point. To the west, however, the brightness of the moon was such as to extinguish nearly all the fixed stars. But one meteor out of the whole number was observed to be an exception to the general law of radiation; and that one, apparently originating in the right foot of the Great Bear, crossed the lines of the radii to the east.

Mr. Barnard adds: "On the whole this exhibition, though not of astonishing brilliancy, was one of a very satisfactory nature to the philosophic observer. It was such as to confirm in a very remarkable manner, the general inferences of Prof. Olmsted regarding the meteors of November. All the observations of Mr. O. regarding the distinctive appearances of these meteors to the eye, were abundantly corroborated."—(*New York Commercial Advertiser.*)

There is some reason to believe that the splendid fire ball mentioned by Mr. Barnard as occurring about 5 o'clock, was seen at several places remote from each other. A meteor answering nearly to this description, though somewhat less splendid, was observed here about the same time, allowing for the difference of longitude. I learn also by a letter from President Humphreys, of St. John's College at Annapolis, Md., that, at the same time, "a very brilliant meteor was seen there, which fell from the direction of the zenith towards the east point." The occurrence of a meteor, attended with similar circumstances in respect to time, splendor and direction, is also mentioned in a letter from Mr. Frederic Merrick, Preceptor of Amenia Seminary, Dutchess Co., New York. Were these several observations accurately collected, they might perhaps afford sufficient data for determining the height of this meteor.

At *Mount St. Mary's College*, Emmittsburg, (Maryland,) as I learn by a communication from Mr. L. Obermeyer, several of the professors and students watched during the whole night. No meteors were seen until twelve minutes past one; from that time the number gradually increased until half past four, when they succeeded each other more rapidly than at any other time. My correspondent himself commenced his observations at fifteen minutes before four, and continued them until five. During this period he counted 52 meteors. He adds: "A great many had been previously seen by Prof. Clark and others, and comparing notes, I find the same principles prevailing throughout, as far as relates to the point of emanation, courses, velocities and trains. With few exceptions they all radiated from the constellation Leo, diverging towards every point. The interval between them varied from half a minute to five minutes. In one or two instances, two diverged from the same point at the same time, taking opposite directions."

At *Buffalo*, (New York,) a careful watch was kept up by Mr. Haskins, but dense clouds entirely covered the heavens. At *St. Louis*, (Missouri,) "a watch was maintained by a number of scientific gentlemen every night, from the 11th to the 14th, inclusive. On the 11th and 12th, the sky was constantly overcast. On the 13th and 14th, the sky was clear, but there was no appearance indicating a return of the phenomenon."

At *Western Reserve College*, (Ohio,) very seasonable and efficient arrangements for observation were made under the direction of Prof. Loomis. The company consisted of twelve, each quarter of the heavens being assigned to a separate observer, who watched two hours at a time. The view was interrupted by clouds until a so until half past four. At twenty three minutes before five, the sky had become so cloudy as to prevent further observations. In the clear interval they counted 74 meteors. The greatest number were seen in the southeast, and the least in the northwest; 29 being seen in the southeast, 23 in the northeast, 17 in the southwest, and 11 in the northwest.

It is granted that shooting stars occur in greater or less number at all seasons of the year, and that they are usually frequent in every clear night in the autumnal months; and before we are authorized to infer any remarkable exhibition of them on the morning of the 13th of November of the present year, it is necessary to compare the phenomena as observed on that morning with such as were observed on the mornings preceding and following that.

For many days before and since the 13th, Messrs. Herrick and Haile have watched together in the open air, commencing usually as early as 4 o'clock. Many shooting stars have been seen on every favorable morning. The greatest number seen in a single hour by the two observers, directing their attention different ways, was 32. There was then no moonlight; and the hour was at that period of the night usually most productive of shooting stars. On Saturday morning, November 11th, in the presence of the moon, then approaching the full, the same observers saw but *four* in a *half* an hour. The night preceding the 12th was rainy; but several of my young friends, determined to let no opportunity escape them to collect important facts on this interesting subject, sat up all night with the hope that they might at least catch a glimpse of the stars.

But the following observations of Mr. *E. Fitch*, of the Senior class in Yale College, supply us with very useful materials for making the comparison in question. I give them in his own words.

"The object of these observations was simply to determine, as far as circumstances would permit, how the meteors of the 13th of November compare with those of other mornings. Having, at the commencement of my observations, Oct. 16th, ascertained that the meteors diverged from the constellation *Gemini*, I directed my attention towards this point of the heavens, extending the field of view to thirty or forty degrees in every direction from this constellation. The following is the result of my observations.

Date.		Time of observation.				Num.	No. pr. h.	Average.	Remarks.
Oct.	16	3h.	30m. to	5h.	45m.	8	3.55		
	17	4	00	6	00	12	6.00		
	21	3	30	5	45	28	11.70		
	23	5	00	5	45	8	10.66		
	28	4	00	5	30	17	11.33		
	30	4	15	5	10	16	17.45	10.13	
Nov.	1	3	00	5	15	38	16.88		
	2	3	30	5	00	18	12.00		
	3	3	30	5	15	29	16.57		
	4	3	30	5	15	33	18.85		
	8	4	15	4	30	5	20.00		
	9	4	00	4	15	4	16.00		
	"	5	00	5	15	3	12.00		
	11	5	30	4	45	10	8.00		Moon fulls 12 d. 6h. 21m. M.
	13	3	15	5	15	34	17.00		Moonlight, 1 day after full.
	15	3	45	4	15	5	10.00		Ditto. 3 do.
	"	4	45	5	15	6	12.00		Ditto. do.
	16	3	45	5	15	6	4.00		Ditto. 4 do.
	17	4	15	5	15	9	9.00		Ditto. 5 do.
	22	4	05	4	30	6	14.04		Ditto. 10 do.
	"	5	12	6	00	11	13.75		Ditto. 10 do.
	28	4	10	5	15	36	33.23	14.58	New moon.
Dec.	5	5	00	5	30	13	26.00		
	7	5	00	5	30	11	22.00	24.00	

" It has been already remarked, that when I commenced my observations, the meteors appeared to diverge from the constellation *Gemini*. As to a definite point of divergence, I was unable to fix upon any with certainty; the region of divergence however, manifestly moved on through the constellation *Cancer*, and on the morning of the 13th Nov. it was in the neck or breast of *Leo*. From the time when I commenced observing, the number of irregular meteors (that is, of those whose direction was not from the region of general divergence) has increased in comparison with the whole number seen; and since the 13th, it has been so great, that the most that can be said is, that the majority appear to come from the constellation Leo. The time when I have found the meteors most numerous, is during the hour *from half past three to half past four*. As far as can be determined from what observations I have made since the 13th, as many as *two thirds* or *three fourths* of those that are visible in the absence of the moon, would be invisible in the light of the full moon."

At this place (New Haven) the night of the 13th was cloudy. It appears, as before mentioned, (see page 385,) that it was clear at St. Louis, in Missouri, but that the observers there could detect no unusual number of meteors. On Tuesday night, the 14th, occurred one of the most magnificent exhibitions of the Aurora Borealis. Mr. Barnard observed this with great attention in New

York, being favored with a clear sky, while it was here partially or wholly covered with clouds. During the latter part of the night, after the aurora had disappeared, Mr. B. gave his attention to the shooting stars. He observes, "I watched steadily for an hour and a quarter, and saw only *three* trifling ones. I had seen one before, early in the evening."

On the morning of the 5th of December, when the moonlight was gone, and the sky was in all respects favorable, I kept up a strict watch of the eastern part of the heavens from 3h. 20. to 4h. 20m., during which time I counted 21 meteors. I kept my record in two columns, placing such as appeared as bright as stars of the third magnitude, and which might have been seen on the morning of the 13th Nov. in one column, and such as were feebler than stars of the third magnitude in another column. The footing of the columns was respectively 7 and 14, indicating that two thirds of the whole number would not have been visible in full moonlight. Mr. Fitch observed on the same morning, and made a similar estimate entirely independent of mine, but with precisely the same result. Messrs. Herrick and Haile express the opinion, that of those meteors observed by them on dark nights, *three fourths* would have been invisible on the morning of the 13th November. Indeed, the most they could ever see in an hour in full moonlight were only eight, while in a corresponding hour in the absence of the moon, they counted 30. The meteors seen by me on this occasion, nearly all proceeded from around the lower part of the constellation Leo. But the region of divergence, instead of being as on the 13th a definite point, was a circular space of more than twenty degrees diameter. The directions of the meteors were such also as frequently to cross each other's paths. Such too, I am authorized to say, have been the appearances as observed by Messrs. Herrick and Haile.

With the foregoing facts in view, we proceed to the inquiry, *Whether on the morning of the* 13*th of November, of the year* 1837, *there was or was not an extraordinary exhibition of shooting stars, analogous to the "Meteoric Shower," which had occurred at the corresponding periods for six years before?*

The peculiar characteristics by which this phenomenon has been attended, have been heretofore enumerated as follows;—(1.) a *number* greater than usual—(2.) a *radiation* of nearly all from one center, situated in the constellation Leo—(3.) *trains* more frequent and vivid than ordinary—and, (4.) a *maximum*, or period of greatest frequency, at 4 o'clock in the morning.*

With regard to the period of greatest frequency, it appears by the observations of Mr. Fitch, (p. 387,) that on a number of mornings previous to the 13th, four o'clock seemed likewise to be the time of the maximum. A very unusual proportion of the meteors seen on the present occasion were accompanied by vivid trains; but as the light of the moon would have prevented many others not accompanied by such trains from being seen, we cannot, in the present instance, employ this characteristic to prove the analogy of this exhibition with the meteoric showers of previous years, although we have much reason to believe that this characteristic would have been very obvious, had it not been for the presence of the moon. But we allege the following arguments as decisive of the occurrence of the meteoric shower, on the morning of the 13th November.

1. The number of meteors actually seen on that night, in the two eastern quarters of the heavens, was in fact greater than on the corresponding hours of any other night before or since, notwithstanding the unusual brightness of the moon.

2. Still, at the lowest estimate made by any of the observers, *two thirds* of the whole number must have been lost in the moonlight, and therefore, we may safely estimate the entire number that would have been visible had the moon been away, at three times two hundred and twenty six, that is, at six hundred and seventy eight,—a number far greater than ordinary. The greatest number of shooting stars seen by any observer during the present season, were counted by Mr. Fitch on the 28th of November, from 4h. 10m. to 5h. 15m., in which time he saw 36, being at the rate of 33 per hour. Yet on the morning of the 13th, I counted in the same quarter of the heavens, between the hours of half past four and half past five, 32 meteors, which multiplied as before by 3, gives for the number that would have been seen in the absence of the moon 96,—a number almost three times as great as the greatest number observed at any corresponding hour of other nights. We do not deem it fair to make the comparison with other seasons of the year, especially when the number with which the comparison is made was unusually large,—such, for example, as the number seen on the 9th or 10th of August, since there is reason to believe that

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* See the Report for 1836, in the 31st volume of this Journal, p. 386.

that time constitutes one of the periods of the recurrence of the phenomenon.

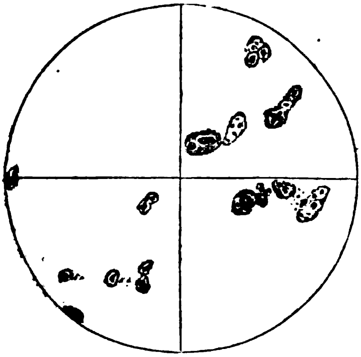
3. As in preceding years, nearly all the meteors moved in lines which radiated from the same centre; and the point of radiation was as heretofore in the constellation Leo, and almost precisely in the same part of Leo as the "radiant" of last year.

The fact noticed by Mr. Fitch, that, on the 16th of October, the radiant was in Gemini, and moved successively forward in the direction of the earth's motion in its orbit, keeping nearly or exactly in the line of its tangent, is an observation of great interest and importance, and plainly indicates a connexion between the phenomenon and the revolution of the earth around the sun, a connexion which has been recognized from many other independent sources of evidence. It is also a fact of similar interest, that the radiant point of the shooting stars was always in the region occupied by the extreme visible portions of the *Zodiacal Light*, or rather a little westward of the *visible* parts of that light. This light has been very conspicuous in the east the present autumn. As early as October 5th, it became distinctly visible in the east before the dawn of day, reaching as high at least as the Nebula of Cancer. It travelled eastward nearly at the same pace with the sun, and, on the 2d of November terminated near Regulus, and had sensibly increased in brightness. On the morning of November 8th (the last time I saw it before the 13th) it was still brighter, and advancing at nearly the same rate as before. The western sky had for some time been unfavorable for observations on this light, on account of the moon; but on the 29th of October I searched for it diligently in the western sky, after twilight, but could not detect the least trace of it. As soon after the 13th, as the absence of the moon and the state of the weather would permit, I began to renew the search in the west. Although very soon after the 13th, that part of the milky way where the Zodiacal Light usually crosses it, appeared more luminous than common, yet the illumination was ambiguous from the presence of Venus, and I could not feel certain of seeing the Zodiacal Light until the evening of the 21st, when, in company with three of my astronomical associates, I observed it under very favorable circumstances. At 7 o'clock in the evening, (Venus being near the horizon, and hidden behind a cloud,) we were severally able to define the boundaries of the Zodiacal Light. By fixing the right eye on the milky way near the Eagle, and the left eye near the head of Capricornus, we could discern a luminous pyramid less bright than the milky way, but still sufficiently distinct to say it was there, its upper edge grazing Alpha Capricorni, and the vertex reaching to the right shoulder of Aquarius.. Its light was very feeble and diffuse, but the triangular space between it and the milky way, embracing the Dolphin, was perceptibly darker.

On the 26th of November, the moon being away, I looked for the Zodiacal Light again in the morning sky, and was surprised to see it so bright,—much brighter I think than it has appeared for the several preceding years when I have watched it after the 13th of November. It was now, therefore, visible on both sides of the sun, having an elongation from that luminary, in the region of the ecliptic, of 60° in the morning and 90° in the evening sky. From this time I could hardly discern any change of place in it in the morning, reaching uniformly to near γ Virginis, nor any perceptible diminution of brightness until December 5th, when the brightness evidently began to decline, and on the 9th (the last time I saw it in the east) the light was comparatively feeble, until just before day, although its visible dimensions were nearly as great as for some days before.

In the evening sky, meanwhile, the Zodiacal Light increased rapidly in brightness, and advanced along the ecliptic faster than the sun. On the 2d of December, after the moon was set, it could be seen, rising to the meridian, at an elongation from the sun of not less than 120°, while its elongation on the other side of the sun was nearly 60°. Its entire dimensions had therefore expanded since November 26th, being now 180° in length, while it was then only 150°. At the present time (December 12th) the moon prevents observations both morning and evening. Were it not for Venus, (now of a dazzling splendor,) my previous observations would lead me to expect to see it become shortly very conspicuous in the west, while in a few days it would cease entirely to be seen in the east. *Does not this great and sudden expansion, covering at the same time both sides of the sun, indicate something of the nature of an inferior conjunction?* And would not such a position result, from the change of position which the earth would take with respect to a nebulous body of great extent, lying over the earth's orbit, through the *skirts* of which the earth passed on the 13th of November, but, moving more rapidly than that body, throwing the sun behind it, as seen in perspective? My meaning, perhaps, will be better comprehended by a diagram.

Whether (as some have supposed) the *Spots on the Sun* have any connexion with the Zodiacal Light or not, it may not be improper to record the fact, that these spots have, for a few weeks past, been very remarkable for their number, magnitude and frequent changes. On the 13th of November, there were on the sun's disk, *eight* distinct groups visible in the finder of Clarke's Telescope, which, with a power of 55, were resolved into more than *sixty* distinct spots. By the 20th of November, some of the larger groups had moved off the disk, and the remaining spots were less remarkable than before. To-day, however, (Dec. 13th,) they are as numerous and striking as ever, presenting at 10 o'clock, A. M. an appearance like the following, the comparative dimensions of the spots being increased a little for the sake of distinctness.*



On the night of the meteoric shower, the *Magnetic Needle* was carefully observed, at this place, by Mr. Herrick; at St. John's College in Maryland by President Humphreys; and at Mt. St. Mary's College in the same state, by Mr. L. Obermeyer. At none of these places was any peculiar change in the needle detected.

The *Barometer* and *Thermometer* were attentively watched by Mr. Charles Rich, but no remarkable changes either of pressure or of temperature were observed; and such is the testimony on this point of observers in other places.

The night of the 14th of November, as already remarked, was signalized by an *Aurora Borealis* of the most magnificent description. Through the kindness of my friends and correspondents, I am in possession of numerous papers relating to this phenomenon, which I had purposed to collate in a separate article; but my limits do not permit its publication in the present number of this Journal.

Yale College, December 13th, 1837.

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[*] I am indebted for this diagram to Mr. A. B. Haile, who has examined the sun daily since the 13th of November.

2. *Extraordinary case of electrical excitement, with preliminary remarks by the Editor.*—The facts stated below, were, by my request, kindly communicated for this Journal by Dr. Willard Hosford, a respectable physician of Orford, New Hampshire, the place where the occurrence happened. Being in that place in September, and finding the belief in the facts to be universal, particularly on the part of persons of judgment and science, (as at the neighboring University, Dartmouth, at Hanover, eighteen miles south,) I became desirous of preserving a record of them.

Dr. Hosford remarks in the letter accompanying his communication, that abundant evidence from the most intelligent persons is at hand for the support of every point in the case. He observes also, that the appearance of the aurora during which the electrical excitement of the lady took place, "was precisely the same as that described by some gentlemen at New Haven."

Speaking of it Dr. Hosford adds, that "the heavens were lighted with a crimson aurora of such uncommon splendor, as to excite no ordinary emotions in every observer, and we had, he observes, in addition, an electrical exhibition much less dazzling, but more singular and to the parties concerned more interesting."

A lady of great respectability, during the evening of the 25th of January, 1837, the time when the aurora occurred, became suddenly and unconsciously charged with electricity, and she gave the first exhibition of this power in passing her hand over the face of her brother, when, to the astonishment of both, vivid electrical sparks passed to it from the end of each finger.

The fact was immediately mentioned, but the company were so sceptical that each in succession required for conviction, both to see and feel the spark. On entering the room soon afterward, the combined testimony of the company was insufficient to convince me of the fact until a spark, three fourths of an inch long, passed from the lady's knuckle to my nose causing an involuntary recoil. This power continued with augmented force from the 25th of January to the last of February, when it began to decline, and became extinct by the middle of May.

The quantity of electricity manifested during some days was much more than on others, and different hours were often marked by a like variableness; but it is believed, that under favorable circumstances, from the 25th of January to the first of the following April, there was no time when the lady was incapable of yielding electrical sparks.

The most prominent circumstances which appeared to add to her electrical power, were an atmosphere of about 80° Fah., moderate exercise, tranquillity of mind, and social enjoyment; these, severally or combined, added to her productive power, while the reverse diminished it precisely in the same ratio. Of these, a high temperature evidently had the greatest effect, while the excitement diminished as the mercury sunk, and disappeared before it reached zero. The lady thinks fear alone would produce the same effect by its check on the vital action.

We had no evidence that the barometrical condition of the atmosphere exerted any influence, and the result was precisely the same whether it were humid or arid.

It is not strange that the lady suffered a severe mental perturbation from the visitation of a power so unexpected and undesired, in addition to the vexation arising from her involuntarily giving sparks to every conducting body that came within the sphere of her electrical influence; for whatever of the iron stove or its appurtenances, or the metallic utensils of her work box, such as needles, scissors, knife, pencil, &c. &c. she had occasion to lay her hands upon, first received a spark, producing a consequent twinge at the point of contact.

The imperfection of her insulator is to be regretted, as it was only the common Turkey carpet of her parlor, and it could sustain an electrical intensity only equal to giving sparks one and a half inch long; these were, however, amply sufficient to satisfy the most sceptical observer, of the existence in or about her system, of an active power that furnished an uninterrupted flow of the electrical fluid, of the amount of which, perhaps the reader may obtain a very definite idea by reflecting upon the following experiments. When her finger was brought within one sixteenth of an inch of a metallic body, a spark that was heard, seen, and felt, passed every second. When she was seated with her feet on the stove-hearth (of iron) engaged with her books, with no motion but that of breathing and the turning of leaves, then three or more sparks per minute would pass to the stove, notwithstanding the insulation of her shoes and silk hosiery. Indeed, her easy chair was no protection from these inconveniences, for this subtle agent would often find its way through the stuffing and covering of its arms to its steel frame work. In a few moments she could charge other persons insulated like herself, thus enabling the first individual to pass it on to a second, and the second to a third.

pass from the end
ball on the stove; these were quite brilliant, di
in any part of a large room, and sharply
to another person. In order further to tes
measure, it was passed to the balls by four pe
this, however, evidently diminished its intens
bright.*

The foregoing experiments, and others of
indefinitely repeated, we safely say hundreds
who witnessed the exhibitions they were pe
much so as if they had been produced by an
the electricity accumulated in a battery.

The lady had no internal evidence of this
generis; it was manifest to her only in the ph
ing her by sparks, and its dissipation was impe
ing her room or seated in a common chair, eve
had previously arrived at the point, of affording
sparks.

Neither the lady's hair or silk, so far as wa
in a state of divergence; but without doubt th
dress being thick and heavy, and to her hair hav
at her toilet and firmly fixed before she appeared

As this case advanced, and supposing the el
sulted from the friction of her silk, I directed (afte
tire change of my patient's apparel, believing tha
one of cotton, flannel, &c. would relieve her fro
conveniences,† and at the same time a sister, the
by my request, assumed her dress or a precisely
both instances the experiment was an entire fa
abated the intensity of the electrical excitement
stance, or produced it in the latter.

My next conjecture was, that the electricity
friction of her flannels on the surface, but this su

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* It is greatly to be regretted that the spark had not beer
den bottle until it would accumulate no longer, and then t
persons to receive the shock.—*Ed.*

† This could hardly have been expected from non-conduct
that the lady was relieved of the electricity by a free com
earth by a good conductor, in the manner of a lightning rod
stove and its connection with the earth through the medium o

destroyed when at my next visit I found my patient, although in a free perspiration, still highly charged with the electrical excitement. And now if it is difficult to believe that this is a product of the animal system, it is hoped that the sceptics will tell us from whence it came.*

In addition to the ordinary appurtenances of a parlor, it may be proper to add, that the lady's apartment contained a beautiful cabinet of shells, minerals, and foreign curiosities.

This lady is the wife of a very respectable gentleman of this place; she is aged about thirty, of a delicate constitution, nervous temperament, sedentary habits, usually engaged with her books or needlework, and generally enjoying a fine flow of spirits.

She has, however, never been in sound health, but has seldom been confined to her bed by sickness even for a day.

During the past two years she has suffered several attacks of acute rheumatism, of only a few days' continuance, but during the autumn, and the part of winter preceding her electrical development, she suffered much from unseated neuralgia in the various parts of her system, and was particularly affected in the cutis vera, in isolated patches; the sensation produced being precisely like that caused by the application of water heated to the point a little short of producing vesication; in no instance, however, did it produce an apparent hyperæmia, but about the last of December a retrocession took place of this peculiar irritation, to the mucous membranes of the fauces, œsophagus, and stomach, there producing a very apparent hyperæmia, and attended, during the exacerbations, with burning sensations that were torturing indeed; and it was for the relief of these symptoms that medical means were used, but it was found no easy matter to overcome this train of morbid action.

It was nearly immaterial what medicines were used; no permanent relief was obtained, and no advantage resulted from the use of the alkalies, or their varied combinations. In a few instances, a dose of the acetate of morphine was given to secure a night's rest, but she seldom made use of an anodyne.

The effervescing soda draught being very acceptable was freely given—from which, in addition to a rigid system of dietetics, the influence of the opening spring, and the vis medicatrix naturæ, relief came of her electrical vexations, of most of her neuralgia, and other corporeal infirmities, and to this time, a much better state of health has been enjoyed than for many years.

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* It appears to be Dr. Hosford's opinion, that the electricity was not caused by the aurora that was coincident with its first appearance, but that it was, in some way, an appendage of the animal system.—*Ed.*

Orford, N. H., Nov. 16, 1837.

3. *Impressions of feet in rocks.*—Those who are acquainted with the earlier volumes of this work, may remember that in Vol V. at p. 223, there is a full account, with a drawing, of the famous copies of human feet found in limestone near St. Louis. In a letter to the editor, recently received from an eminent English geologist, dated September 9, 1837, are the following striking remarks:

"Lest I should again neglect to call your attention to a subject to which I have long since intended to claim your particular regard, I will in this brief space allude to it. In the 5th volume of your Journal, (1822,) there are remarks on the prints of human feet observed in the secondary limestone of the valley of the Mississippi, by Mr. Schoolcraft and Mr. Benton, with a plate representing the impressions of two feet. Ever since my researches on the rippled sandstones, (published in Jameson's Edinburgh Journal,) I felt persuaded the prints alluded to were the genuine impressions of human feet, made in the limestone when wet. I cannot now go on with the arguments that may be urged in proof of my opinion; but rely upon it, those prints are certain evidence that man existed at the epoch of the deposition of that limestone, as that birds lived when the new red sandstone was formed. Pray get all the evidence on this head you can—rely upon it most important results will be the consequence. I am prepared to find man and the cotemporary animals much lower down in the series than is generally supposed. My friend Sir Woodbine Parish, (the discoverer of the Megatherium,) tells me that similar impressions have been seen in South America; and there was a dispute among the catholics whether they were the feet of the apostles! But truth often lies hid beneath such strange conceits. I can remember the time when my explanation of the rippled sandstones was ridiculed, now no one doubts it."

To these remarks of our respected correspondent, we add the following fragment, dated Baltimore, Oct. 14, 1836, and addressed to the editor.

"Having lately read in your Journal the communication of Prof. Hitchcock concerning the impressions of birds' feet on the sandstone in the Connecticut valley, I was reminded of having read something of an analogous kind many years ago concerning a locality in Tennessee, which I would beg leave to lay before you under the hope that some of your intelligent readers in that neighborhood may examine into this subject more particularly.

"Extract from the American Encyclopedia, published by Dobson at Philadelphia, 1778 to 1803—Supplement, vol. 3, p. 344. From a meagre account of Tennessee, I extract the following: 'The enchanted mountain, about two miles south of Brass town, is famed for the curiosities on its rocks. There are on several rocks a number of impressions resembling the tracks of turkeys, bears, horses, and human beings, as visible and perfect as if they were made on snow or sand,' &c. There are other particulars stated which seem to be loose guesses of ignorant people, &c."

We are not aware whether Dr. Troost, the learned and able geologist of Tennessee, has investigated these facts, or whether they have fallen under his observation. If the alledged facts are real, we should be glad to know his opinion of them, and we should be greatly obliged, if in compliance with our English correspondent and with our own, any facts may be communicated relating to impressions on rocks.—Ed.

November 18, 1837.

4. *New locality of Iolite, with other minerals associated.*—About two years ago, I discovered a locality of *iolite* in this place. I have subsequently revisited it, and take this opportunity of communicating to you the result of my observations.

The *iolite* is found about one mile and a half N. E. of the village of Brimfield, on the road leading to Warren, and near the residence of Samuel Patrick. It is of a violet blue color, sometimes with a shade of brown: fracture uneven: translucent: structure foliated. I have obtained no specimens which show the crystalline form. Externally, it differs very little from that found at Haddam, Conn., except that the hues are more vivid, and the tabular masses are not as large. I am not aware that other localities have been discovered in this country. The accompanying rock is well characterized granite.

In connexion with the *iolite*, occurs *adularia* of a wine yellow and sometimes greenish tint. Some of the specimens possess the chatoyant appearance. They display a strong pearly lustre, and are often nearly transparent. In some specimens the minute foliæ are perceptible, giving them a striated appearance. Few localities afford better specimens.

Sulphuret of molybdenum,—in imperfect hexahedral prisms: structure lamellar. Abundant, though disseminated in dots throughout the mass.

Mica,–black: in six-sided tables. Good specimens can be obtained.

Garnet,–occurs abundantly: crystallized imperfectly, and massive.

This locality, as yet, has been but partially explored.

J. W. Foster, *of Zanesville, Ohio.*

Brimfield, Mass., Dec. 7th, 1837.

5. *Caoutchouc.*—Much attention has been bestowed upon this article, with a view of discovering some solvent or mode of reducing it to a consistence capable of receiving any desirable form, or of being applied to the surface of cloth in the form of varnish, in order to render it water proof; but believing that no method has yet been made public by which it could be used with economy and facility, I am induced to offer the following, with the hope that it will be found both useful and interesting.

I wish to premise, that all hitherto known solvents of *caoutchouc* are liable to objections. In a trial which I once made, I found that oil of turpentine dissolved *raw* caoutchouc tardily; and on having been spread on calico and exposed to the atmosphere, it remained glutinous at the end of a year.

About two years ago, I was induced to perform some experiments with caoutchouc, and I accidentally ascertained, that if it be previously cut fine and immersed in common sul. ether or a solution of (some alkali? I used) carb. soda, 2 oz. to a pint of water, for a week, and then put into *good new* oil of turpentine, it dissolved with facility; and when spread on cloth and exposed to a dry atmosphere, it *speedily dries and assumes its original properties,* usually in twenty four hours.

Calico, linen, or articles of clothing, may receive a coating with this solution, sufficient to render them water proof without materially altering their general appearance or injuring their pliability.

When less elasticity and more body is required, I hazard a conjecture, that this solution may economically be diluted or mixed with asphaltum, Venice turpentine, or some other articles soluble in oil of turpentine. Arza Andrews, M. D.

Meriden, Ct., Nov. 29th, 1837.

6. *On meteoric showers in August; supplementary to Art.* XX.—The facts below given, came to hand too late for insertion in their proper place. For those marked *a.* and *b.* I am indebted to the kind attention of my friend, Mr. Geo. C. Schaeffer, of New York.

a. The following is the entire statement concerning the meteors seen in England, Aug. 10, 1833, an imperfect account of which was given at pp. 178, 179 of this volume.

> "A very remarkable flight of falling stars was seen between 10 P. M. and midnight, on the evening of Aug. 10, (1833,) about midway between Worcester and Great Malvern. They resembled the almost incessant discharge of sky-rockets in the upper regions of the atmosphere, and the trailing light they left upon the sky was particularly curious and beautiful. This appearance continued for a considerable time; the velocity with which the meteors appeared to move was very great. Some of them were nearly in the zenith, but none approached the horizon. The general direction of their course was from Northwest to Southeast."—Lees: Analyst, Aug. 1834.

b. In a register of the weather, kept at Edmonton, near London, by Mr. C. H. Adams, published in the London Literary Gazette, in the report for the week Aug. 2–8, 1834, it is stated, "the innumerable meteors which are nightly seen, shooting in all directions, are worthy of notice, as were those especially from 9 to 11 on the evening of the 9th inst."—Compare (5), p. 136.

c. By No. 218 of *L'Institut*, received here on the 11th Dec., it appears that M. Quetelet, at the session of the Royal Academy of Brussels, Dec. 3, 1836, stated his belief that shooting stars were unusually frequent about the middle of August, and more particularly on the 10th. In order to find facts in relation to this subject, he examined the Register of the Observatory of Brussels. The only observations there recorded of extraordinary appearances of these meteors, refer to Aug. 10, 1834, and Aug. 10, 1835. No special attention had, however, been given in the Register to observations of these phenomena.—L'Institut, *fol. Paris, No.* 218, *p.* 256. *Aout*, 1837.

At the time when the last number of this Journal was published, I was not aware that any person in Europe or elsewhere, had ever advanced the idea of a meteoric shower in August.

The statement on p. 359 concerning the *tangential region*, is inaccurate in the unrestricted form there given. In our latitude, it is true only about the times of the solstices, but in the intertropical latitudes it would, without much variation, hold true, during the year. The general propriety of the conclusion there stated, viz. that the showers would have been found more abundant after midnight, remains however unaffected. If we assume the radiant of August 9 to be in the ecliptic, and 90° West from the sun's place, it will be found to rise about 10*h*. 40*m*. P. M. This may account for the fact that about that time of the year, meteors have been seen so abundantly before midnight.

We have now an August meteoric shower, in five successive years, (1833 to 1837 inclusive,) and there seems to be little risk in predicting its recurrence on or about the 9th of next August. For several reasons, and especially on account of our early dawn at that season, it is extremely important that persons who live near the equator, in all quarters of the globe, should make careful observations on this interesting phenomenon. E. C. HERRICK.

New Haven, Dec. 15, 1837.

7. *Brilliant Meteor seen in the day time.*—On Saturday, August 20, 1836, being in the state of Illinois, on the road between Winchester and Jacksonville, and about eight miles southwest from the latter place, (which is near N. lat. 39° 45′, and W. long. 89° 40′,) a brilliant meteor or globe of fire was seen both by myself and companion. Its true bearing was about N. 15° E., nearly. Its apparent size was about fifteen minutes of a degree; or, the apparent disc was about one fourth that of the moon. When first seen it had an altitude of about 60°; it moved rapidly in a line nearly vertical, and became invisible at an altitude of about 40°. It would doubtless have been seen at a greater elevation had the eye at first been properly directed. The sky at the time was entirely clear, and the sun shining bright; it being about four o'clock in the afternoon. The meteor left behind a distinct train of smoke, which appeared like a small cloud and was visible for at least fifteen minutes. An explosion was noticed by several persons in the vicinity, which I failed to hear on account of the noise made by the wagon in which I was traveling. R. GAYLORD.

8. *A Synopsis of the family of Naïades*; by ISAAC LEA, Philadelphia, 1836.—This work deserved a notice at our hands long since, but it has been mislaid and overlooked. Mr. Lea's reputation is too well and too extensively known to need any encomium from us: his name is identified with American conchology, and no student sees the word *Unio*, without being reminded of our author and his distinguished services. In this synopsis are enumerated three hundred and fifty four species, recent and fossil.

In his introduction, Mr. Lea justly remarks on the difficulty experienced in attempting any correct and unobjectionable division of a family, in which the distinctive characters of species are so blended and run into each other, as scarcely to be separated by the most minute care. In doing this he has certainly succeeded better than his predecessors, and the number of new species brought forward is quite remarkable. He divides the family into two genera, *Margarita and Iridina*, and the first into the sub-genera Unio, Margaritana, Dipsas, Anodonta and Pleiodon. A writer in the Zoological and Botanical Journal some time since, called in question several species of the genus *Unio* which Mr. Lea had described as his own, attributing them to other zoologists; these species, we observe, Mr. Lea still sees proper to retain, for which he doubtless has satisfactory reasons.—B. S., Jr.

9. *Temperature of Lake Ontario.*—This lake is so large and deep that it never freezes in winter to any great extent. The ice formed along the shores in still weather is dashed to pieces, and in part thrown upon the banks by the first wind that raises its waves. The ice is formed too in much greater quantity late in winter, when the water has had time to cool. In the severe winter of 1835–6, the steam boat Traveler ran through the winter from Niagara to Toronto, in Canada, a distance of about thirty six miles. In March, of that winter, the ice once covered the water for the whole distance and was broken through, as it was not thick, by the boat. The wind soon dashed the ice in pieces. The ice then extended several miles from the westward of the lake. But so much ice is a rare occurrence on this lake, and takes place only in a severe winter, and late too in the season, when the waters have been unruffled by winds for some days, or, as the engineer of the boat remarked, *during a long calm.*

The surface of Lake Ontario is about two hundred and forty feet above tide water. It is said to have been *sounded* to the depth of *three hundred* feet, which would place its bottom below the level of the sea. It is doubtful whether the statements on the depth of the great lakes can be relied upon. It is quite certain that some are given far too large. Lake Erie freezes to a great extent, if not entirely over its surface; but Lake Ontario is so deep that even with the discharge of the cooled water of Lake Erie into it, the waters are rarely lowered to the point of congelation.

The climate of this part of the state must be affected by such great bodies of water. As the water is cooled in winter, it must take a considerable time for the temperature to rise to that of the air, and hence the winter must be prolonged a little, and the spring be retarded, and in autumn, the water must be throwing off its caloric to the atmosphere, and retard to some extent the approach of winter. The frequent direction of the wind towards the lake, while the upper air is moving in a different direction and often in a nearly opposite course, shows the influence of the cooler waters of the lake in summer.

At my request Mr. William McAnslan, the engineer of the steamboat Traveler, made the following observations upon the temperature of the lake. The observations began May 5th, 1837.

		May 15.	May 22.	June 19.	July 15.	Aug. 7.	Sept. 4.	Oct. 16	Nov. 13.
1.	Water,	60°	68°	63°	68°	73°	63°	47°	44°
	Air,	63	66	64	67	73	65	50	45
2.	Water,	45	46	60	65	70	63	52	46
	Air,	63	77	65	67	72	64	54	38
3.	Water,	39	39	58	63	69	60	54	46
	Air,	44	44	54	64	74	63	54	36
4.	Water,	37½	38	55	63	68	58	53	44
	Air,	52	40	58	65	72	63	53	38
5.	Water,	37½	38	42	53	64	57	54	45
	Air,	48½	41	55	63	71	60	56	38
6.	Water,	38	38	40	52	64	58	54	45
	Air,	54	39½	54	63	72	59	59	36
7.	Water,	39½	38	40	52	65	59	53	46
	Air,	55	40	50	62	73	59	59	36
8.	Water,	40	39	42	54	66	62	52	47
	Air,	54	44	55	64	73	63	57	33
9.	Water,	42	40	50	58	66	64	52	46
	Air,	55	45	62	67	73	65	56	32
10.	Water,	44	42	53	59	66	64	51	47
	Air,	55	49	63	68	73	65	54	33
11.	Water,	52	51	56	59	63	64	52	45
	Air,	54	54	64	68	72	63	54	40
	Wind,	S.	N. W.	S.	N. W.	S. W.	N. W.	N. W.	N.
	Mean temp. of the day,	70	59	62.3	68.3	74.3	56.3	46	38.6
	Mean temp. of two preced. days,	71.6	57.2	59.6	74.8	62.5	56.5	46.6	46.5

The observations began at the mouth of Genesee River, and were continued to Coburg, on the Canada side. The distance to Coburg is about sixty miles, and the place lies a little W. of N. from this city. The *first* observation was made just in the mouth of the Genesee; the *second* observation, about half a mile from the mouth of the Genesee, where its waters are well mingled with those of the lakes; the *nine* succeeding were made about every six or seven miles, the last being at the landing at Coburg. They were made upon water drawn from about one foot below the surface. It was found however by repeated trials, that the temperature for three feet deep was not sensibly different from that at the surface. At the bottom of the table is given the course of the wind on the day of observation and the mean temperature of that day at Rochester, and also the mean temperature of the two preceding days.

The gradual diminution of temperature from the shore towards the middle of the lake, from spring to September, is an interesting fact. Mr. McAnslan,* who is an engineer of considerable knowledge of chemistry and mechanics, remarks too, that the direction and strength of wind carries the colder portion nearer the shore in the direction of the wind. In August and September, the temperature of the water was nearly uniform from shore to shore. In October and November, the water in the middle of the lake was warmer than nearer to the shores. In spring and down to July, the air on the lake is peculiarly cool from the coolness of the water. In October the temperature of the atmosphere and lake was nearly the same, while the difference was considerable in the preceding month. Finally, it is probable that the current of Niagara River is pretty direct through the lake, and that the accumulation of ice on Lake Erie and its being heaped up and continued on the eastern part of the lake, often till into May, must be in part the cause of the low temperature of the water of Lake Ontario, as shown in the table for the months of May and June. C. D.

10. *Encrinite, Tufa, &c.*—For the benefit of the numerous readers of your Journal, who may or may not be interested in the collection and examination of the organic remains of this country, I beg

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* Some alteration in the position of the floatboards of the *wheels* of the Traveller has been made by Mr. McAnslan, by which they seem to move with more efficiency through water.

leave to state, that a few days since I obtained a petrifaction from the surface of a fragment of limestone from Becraft's mountain, which, after cleaning, proved to be a perfect specimen of the second variety of encrinite, called by Parkinson the cap encrinite. This is the first and only specimen of this family of fossils which has been found in this vicinity. The fossil vertebral remains of this animal constitute the principal part of the rocks of this mountain. Having no figures of the above named fossil in my possession, I cannot conclusively determine whether this be the cap or the pear encrinite; I am however inclined to the opinion of its being the former. I would also state, that I have recently discovered an excellent locality of calcareous tufa about a mile from this city. It is mostly stalactical and very compact, some being susceptible of a beautiful polish. Impressions of fern I lately discovered on shale overlying a narrow vein of coal, about a mile and a half south of this place. I mention the above as being altogether new in this neighborhood.

Hudson, May 22d, 1837. S. A. Rowley.

11. *Description of a New Trilobite;* by Jacob Green, M. D. Prof. of Chem. in Jefferson Med. Coll.

Calymene Rowii. *Green.*

The outline of this fossil as it lies upon the rock presents a very regular oval figure. The buckler and the body are a good deal elevated, and measure longitudinally nearly an inch and two thirds.

The *buckler* is lunate, and is edged round its whole border with a little groove or channel. Its *front* or middle lobe is elevated above the cheeks, is rounded at its anterior part and gradually enlarges as it approaches the middle lobe of the abdomen. There are no tubercles or folds upon it, but its posterior angles are so truncated as to form a subtriangular protuberance on each side of the commencement of the vertebral column. The *cheeks* are shaped like spherical triangles, and seem from our specimen, to have projected on each side to the fourth articulation of the abdomen. The *oculiferous tubercles* are large and lunate; they are placed close to the front and seem almost to form a part of it; they are situated just before the protuberances above mentioned.

The *abdomen* and *tail* can readily be distinguished. There are twenty three articulations in both. The middle lobe is very prominent, is separated from the lateral ones on each side by a deep channel, and gradually and regularly tapers to its termination, which is near the end of the body. The *lateral lobes* are rounded. The *costal arches* of the abdomen have a furrow scooped out of their upper surface, and their outward extremities terminate in obtuse points, between which there is a raised line. The *caudal arches* are not grooved, but there is a faint impressed line running along their upper surface, which is slightly bifurcated at their termination.

This beautiful and highly interesting trilobite was found by Mr. George L. Le Row, of Poughkeepsie, N. Y., to whose kindness I owe this opportunity of describing it. The specific name is given in compliment to the discoverer. There is a strong analogy in some leading particulars between this species and our *C. Diops.* Professor Dalman's C. Concinna represented on his first plate, fig. 5, *a b* and *c*, comes very near it, but there are many marked differences between them. Mr. Le Row in a letter to me states, "the locality of this trilobite is just out of the village of Fly creek, three miles from Cooperstown, in Otsego town and county, N. Y., on the land of a Mr. Williams. No other specimen has been found there. I possess the body of one of the same species obtained about half a mile from the above locality." In the *Poughkeepsie Telegraph*, Nov. 22d, 1837, Mr. Le Row has given a figure of our trilobite, accompanied by the following remarks: "The above specimen of a trilobite was obtained during the past summer, about three miles south of the head waters of the Susquehannah river; it is peculiarly perfect, and the engraving exhibits the outlines of the fossil in a remarkably distinct manner."* It was found imbedded in a layer of soft argillite, slightly ferruginous, and of such is the fossil composed. The strata in which it was found was filled with orthoceræ and numerous other fossils. Immediately under this layer is another of argillite, of harder texture and darker color, and free from petrifactions.

12. *Difference between the English Porcelain and that of Germany and of the continent.*—From an eminent individual perfectly acquainted with both the science and practice of making porcelain, and familiar with the principal establishments in Europe, we learn the following facts:—

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* The figure alluded to is beatifully executed, but the representation of the *front* of the buckler is by no means exact.

"The English porcelain is made upon principles entirely different from those which govern the manufacture of the French and German porcelain. The paste or biscuit, contains alkaline materials, phosphate of lime derived from bones, &c., and is baked at a higher temperature than that which is necessary for the enamel, which contains lead and not feldspar. The German porcelain is composed essentially of kaolin and feldspar; it is baked at the same time with the enamel or glaze, which never contains lead, and is composed essentially of feldspar." These two kinds of pottery so very different, are usually confounded by professors of chemistry.

13. *Mathematical, Philosophical, and Chemical Instruments.*—We have received the lithograph circular of Louis and André Breton, pupils of the celebrated Lenoir & Fortin. Their establishment is Rue Servandoni, No. 4, pres St. Sulpice, Paris.

They pledge themselves to furnish to institutions and individuals, all or any of the instruments necessary to science, in all its branches; manufactured with accuracy and despatch, and at reasonable prices.

We invite the attention of the American scientific public to this establishment.

Our miscellany has been unavoidably abridged in the present No. to make room for articles, and especially for the abstract from the doings of the British Association, which being indeed in themselves miscellaneous, in that way it happens that this department is in fact more extensive than usual, and we may find it necessary to take the same course in the succeeding No.

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APPENDIX

TO THE

AMERICAN JOURNAL OF SCIENCE AND ARTS, VOL. XXXiii, NO. 2.

Davenport's recent Experiments in Electro-Magnetic Machinery.*

(Copy of a letter from Mr. Davenport.)

TO PROF. SILLIMAN.

Dear Sir—Having lately made a number of applications of the power of *large galvanic magnets* in propelling machinery, (being independent of the large machine now constructing by the association,†) I have thought proper to state to you the results, believing they would not be uninteresting to you.

I have constructed a machine, with two revolving magnets, two feet in length, made of iron three and a half inches in diameter, and weighing, after being wound with six coils of No. 10 copper wire, one hundred pounds each. Three stationary magnets of two feet diameter, were placed around the periphery making six poles, and weighing one hundred pounds each.

With this machine I produced one hundred revolutions per minute, with six square feet of sheet zinc exposed to action, surrounded with thin sheet copper.

I then displaced the stationary magnets, and substituted one magnet three inches in diameter, forming a semicircle, with the poles directly opposite each other, and weighing about one hundred pounds. With this magnet I produced one hundred and fifty revolutions per minute, using the same quantity of zinc surface. With one revolving magnet I produced one hundred and seventy-five revolutions per minute, with four square feet of sheet zinc. I next constructed a *hollow* magnet of two feet in length and four inches in diameter, made of boiler iron, five-sixteenths of an inch in thickness, with four coils of copper wire, with which I succeeded in getting one hundred revolutions per minute. A hollow magnet was then constructed of thin sheet iron, of the thickness of common *stove-pipe iron*, which revolved one hundred and fifty times per minute. *Hollow* magnets I think may be used to great advantage where weight is an objection; but in my experiments I generally make use of *solid* iron.

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* Received after the Journal was finished.

† The machine alluded to in the above letter, as now being constructed for the Electro-Magnetic Association, by Messrs. Davenport & Cook, is nearly completed, and is expected to be of about two tons power. It is formed by a combination of small magnets, weighing about four pounds each, and three and a half inches between the poles. These magnets are placed, two hundred thirty four in number, on an iron shaft six feet in length, and a corresponding number in a circle as stationary magnets.

I also constructed a machine with simply two magnets formed of two inch round iron, of fifteen inches in length, of the stirrup form. The distance between the centres of the poles is five inches, and the magnet revolves four hundred and fifty times per minute, with two square feet of zinc. The stationary magnets being placed with the poles pointing upwards, and the poles of the revolving magnet pointing downwards, the shaft to which the revolving magnet is attached passes through its centre, and rests on the centre of the stationary magnet. Two of these machines (weighing in all fifty pounds) I have attached to small drilling-works, which I find produce sufficient power to do all my drilling of iron and steel, to the size of one-fourth of an inch diameter.

I have adopted this form on the third machine which I have recently put in operation. The magnets are formed of two and three-fourth inch iron, with the centres of their poles nine inches apart and weighing 50 lbs. each, with this I produced three hundred revolutions per minute, and have successfully attached it to turning hard wood of three inches diameter. I find the power increases in full proportion to the increase of weight and without increasing in proportion the size of the battery. The wire must be increased in size in proportion to the size of the iron used, and consequently the difficulty attending long wires will always be avoided.

I find no difficulty in using my machine *twelve hours in succession*, without changing batteries or agitating the solution.

I am erecting conveniences to test the powers of each magnet as they are increased in weight and size, and think I shall be able in season for the April number of your Journal to give the exact increase of power in proportion to weight, of magnets weighing from ten pounds to several tons.

I have also made some very satisfactory trials, while making my machines, respecting the expense for the consumption of zinc and acids, and I think I shall soon be able to give nearly the precise cost of making the largest machinery.

Galvanism is, I trust, destined to produce the greatest results in the most simple form, and I hope not to be considered an enthusiast, when I venture to predict, that soon engines capable of propelling the largest machinery will be produced by the simple action of *two galvanic magnets*, and worked with much less expense than steam.

Yours, respectfully,

THOMAS DAVENPORT.

New York, December 26, 1837.